OMEGA SMALL VOLUME GROUP

REMEDIAL INVESTIGATION WORK PLAN

OMEGA CHEMICAL OPERABLE UNIT 2, WHITTIER, CA

EPA Site ID#09BC
Docket No. 9-2004-004

ARCADIS
Infrastructure, buildings, environment, communications

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Date:
1 November 2004

Subject:
Omega Chemical Operable Unit 2, Whittier, California, EPA Site ID#09BC, Docket No. 9-2004-004

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Draft Remedial Investigation Work Plan

Omega Chemical Operable Unit 2, Whittier, CA

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Figures

Appendices

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Remedial Investigation Work Plan

Omega Chemical
Operable Unit 2,
Whittier, CA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY REGION IX

Plan Title	RI/FS Work Plan Omega Chemical Superfund Site Operable Unit 2
Site Name:	Omega Chemical Superfund Site
Site Location:	Whittier
City/State/Zip:	Los Angeles County, California
Site EPA ID#:	09BC
Anticipated Sampling Dates	2004 to 2005
Prepared By:	Ronald Halpern, R.G.
Date:	November 1 2004
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RI/FS Work Plan Approval Date:	____________________

Approved: John Johnsen ____________________ Date: ____________
ARCADIS Project Manager

Approved: Avram Frankel ____________________ Date: ____________
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Approved: Christopher Lichens ____________________ Date: ____________
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Executive Summary

The Omega Chemical Corporation (Omega) is a former refrigerant/solvent recycling operation located in Whittier, California. The facility operated as a Resource Conservation and Recovery Act (RCRA) solvent and refrigerant recycling and treatment facility from approximately 1976 to 1991, handling primarily chlorinated hydrocarbons and chlorofluorocarbons. In August 1993, the United States Environmental Protection Agency (EPA) conducted a Site Assessment at the request of the California EPA, Department of Toxic Substances Control (DTSC). During this assessment, drums of unprocessed hazardous waste were observed at the site. In January 1995, the EPA conducted a second Site Assessment at the request of DTSC and observed drums in various stages of deterioration, including some that were corroded and leaking. Leaking substances were observed by EPA to be migrating to other portions of the site and off site. In May 1995, a time-critical Removal Action Memorandum was signed authorizing a removal action to address the issues of the corroding and leaking drums. The EPA then issued a Unilateral Administrative Order (UAO 95-15) to potentially responsible parties (PRPs) to perform work described by the action memorandum. The UAO was amended on August 31, 1995, to include additional PRPs. Some of the parties named in the UAO established a group identified as the Omega PRP Organized Group (OPOG).

Due to releases of hazardous substances into soil and groundwater, the EPA placed the site on the National Priorities list (NPL) on January 19, 1999. In April 1999, the EPA issued a Special Notice to OPOG members and commenced negations of a Partial Consent Decree requiring response work including non-time-critical removal action and remedial investigation/feasibility study (RI/FS) addressing soils located at or near the site facility. In February 2001, many OPOG members signed the Partial Consent Decree (EPA, 2001).

In January 2004, the EPA issued a Unilateral Administrative Order (UAO 9-2004-0004; the 2004 UAO or UAO) to certain PRPs that had not signed the Partial Consent Decree to perform RI/FS work. The 2004 UAO was amended in June 2004 (First Amended UAO). Fifteen of the parties named in the First Amended UAO, known as the Omega Small Volume Group (OSVOG), retained ARCADIS to perform consultant (and field) services to comply with the First Amended UAO. The Statement of Work attached to the First Amended UAO include the installation and sampling of 11 groundwater monitoring wells in the Omega Chemical Operable Unit 2 (OU-2), to assist in defining the vertical and lateral extent of contamination in groundwater downgradient of the former Omega facility.

This Remedial Investigation (RI) Work Plan was prepared, in general accordance with EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA, 1988)*, to address the Statement of Work for Remedial Investigation Field Activities (SOW) outlined in the UAO.

1. Introduction

This work plan has been prepared to support the Omega Small Volume Group (OSVOG) in conducting a remedial investigation (RI) for the Omega Chemical Superfund Site Operable Unit 2 (OU-2) in accordance with the United States Environmental Protection Agency's (EPA) First Amended Unilateral Administrative Order (First Amended UAO) for Response Action (EPA Region IX, CERCLA Docket No. 9-2004-0004). The work plan was developed in accordance with EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA – Interim Final (EPA/540/G-89/004, OSWER Directive 9355.3-01, October 1988).* The Field Sampling Plan prepared by CH2M Hill (2004) was the source for much of the text of this document.

The Omega Chemical Corporation (Omega) is a former refrigerant/solvent recycling operation located in Whittier, California, a community of approximately 85,000 people (Figure 1-1). The facility is located in the vicinity of residential neighborhoods and within 1 mile of several schools, including three elementary schools and two high schools. The facility operated as a Resource Conservation and Recovery Act (RCRA) solvent and refrigerant recycling and treatment facility from approximately 1976 to 1991, handling primarily chlorinated hydrocarbons and chlorofluorocarbons. Drums and bulk loads of waste solvents and chemicals from various industrial activities were sent to the Omega facility for processing to form commercial products. Chemical, thermal, and physical treatment processes were reportedly used to recycle the waste materials. Wastes generated from these treatments and recycling activities included distillation column (still) bottoms, aqueous fractions, and nonrecoverable solvents. Additional data regarding site history and past investigations and remediation activities are discussed in detail in the *Final On-Site Soils RI Work Plan* (Camp Dresser & McKee [CDM], 2003a) and the *Omega Chemical Superfund Site; Whittier, California, Phase 2 Groundwater Characterization Study Report* (Weston Solutions, Inc. [Weston], 2003).

Chlorinated hydrocarbons (primarily perchloroethylene [PCE], trichloroethene [TCE], 1,1-dichloroethene [1,1-DCE], cis-1,2-dichloroethene [cis-1,2-DCE], and chloroform) and Freons (trichlorofluoromethane [Freon 11] and trichlorotrifluoroethane [Freon 113]) were identified as the primary chemicals of concern in soil and groundwater directly beneath the site. Elevated total chromium also was reported in groundwater beneath the Omega site. Elevated concentrations of chemicals of concern were also reported in groundwater west and southwest of the Omega facility, suggesting that a downgradient migration of the contaminant plume from the site has occurred. Weston

(2003) indicates the possible presence of at least six other potential sources for chlorinated compounds in groundwater downgradient of the Omega site.

2. Site Background and Physical Setting

The following section describes the current understanding of the physical setting of the site, site history, and the existing information regarding the condition of the site.

2.1 Site Location and Topography

The Omega Chemical Facility is located at 12504 and 12512 East Whittier Boulevard in the City of Whittier, Los Angeles County, California (Figure 1-1). The City of Santa Fe Springs is located southwest of the Site. The community of Los Nietos is included within the City of Santa Fe Springs. Unincorporated County of Los Angeles land is located northwest of the site.

The Omega Chemical Facility is located along the base of the La Habra piedmont slope descending from the southwestern flank of the Puente Hills, at an elevation of approximately 220 feet above mean sea level (msl) (Weston, 2003). The piedmont slope descends toward the southwest at a slope of approximately 2.5 percent to a point approximately 2,800 feet southwest of the Omega Chemical Facility. At this point, the ground surface flattens into a broad basin or plain, at an elevation of approximately 150 to 155 feet msl. In the southwestern part of the study area, the ground surface ascends a low rise at the northwest end of the Santa Fe Springs plain, at an approximate elevation of 160 feet msl (Weston, 2003). The site and surrounding areas are completely developed. The Sorenson Avenue drain is a small channelized drainage that flows southeast from the intersection of Dice Road and Slauson Avenue and becomes La Canada Verde Creek to the south of the OU-2 study area (Weston, 2003).

2.2 Site History

The former Omega Chemical facility is a 40,000 square foot parcel that is zoned for industrial use. The facility was a former hazardous waste treatment and storage facility. The surrounding area is a mix of industrial, commercial and residential property.

During its years of operation, drums and bulk loads of waste solvent and chemicals from various industrial activities were sent to the Omega facility for processing to form commercial products. Chemical, thermal and physical treatment processes are believed to have been used to recycle and reuse the waste materials. Due to the release of hazardous substances into the groundwater, EPA proposed the Site for listing on the National Priorities List ("NPL") in September 1998. The Site was placed on the NPL on January 19, 1999.

2.3 Local Geology and Hydrogeology

The following information on regional hydrogeological setting is largely based on the California Department of Water Resources (CDWR) Bulletin 104 (1961).

The site is located in the Central Basin of the Coastal Plain of Los Angeles County. The Coastal Plain is bounded on the west and south by the Pacific Ocean and by mountains on the north, east, and southeast. The Coastal Plain is underlain by an extensive groundwater basin in Los Angeles and Orange Counties.

Water-bearing sediments identified in the Whittier area extend to an approximate depth of at least 1,000 feet below ground surface (bgs). The identified geologic units consist of recent alluvium, the upper Pleistocene Lakewood Formation and the lower Pleistocene San Pedro Formation. Figure 2-1 shows a generalized stratigraphic column of water-bearing sediments in the Whittier area. The Pliocene and Miocene marine sediments below the San Pedro Formation generally contain saline water in the Whittier area, although locally can contain fresh water. These units are considered non-water-bearing where exposed in the Puente Hills and include the Pliocene Pico and Repetto Formations and the Upper Miocene Puente Formation.

The major geologic structures in the area include a homocline that underlies the La Habra piedmont slope, the northwest-trending La Habra syncline underlying the alluvial basin, and the west-northwest trending Santa Fe Springs anticline situated below the slightly uplifted Santa Fe Springs plain. The La Habra syncline affects the San Pedro Formation and, to a lesser extent, the Lakewood Formation, and has a surface expression as the axis of the basin. The Santa Fe Springs anticline folds both the San Pedro and Lakewood Formations; shallow aquifers to thin across the crest of the anticline. The west-northwest trending Whittier fault is located northeast of the site in the Puente Hills (CDWR, 1961).

As reported by CDWR (1961), the uppermost unit in the vicinity of the Omega site consists of the "Bellflower Aquiclude." The Bellflower Aquiclude comprises all the fine-grained sediments that extend from the ground surface down to the first aquifer. The Bellflower Aquiclude consists primarily of clay and sandy clay to silt, and ranges from 20 to more than 40 feet in thickness in this area. CDWR (1961) considers the Bellflower Aquiclude to be present in both the recent alluvium and the upper part of the Lakewood Formation. In the Whittier area, the Bellflower Aquiclude is considered to be entirely within the Lakewood Formation. Water-bearing zones locally occurring within the Bellflower Aquiclude are referred to collectively and informally as the Semi-perched Aquifer.

The Lakewood Formation consists of non-marine deposits of Late Pleistocene age and attains a maximum thickness of 70 feet. The Gage Aquifer is the major water-bearing member and comprises the basal stratigraphic unit of the Lakewood Formation. It consists of about 30 feet of sand with some interbedded clay. Based on previous investigations at the Omega site, the Gage Aquifer appears to be absent beneath the site proper. A sand interval found in exploratory borings a short distance southwest of the site is believed to correlate with the Gage Aquifer (England and Hargis, 1996). The Gage Aquifer is interpreted by CDWR (1961) to extend eastward approximately 2.5 miles south of the site. However, exploratory borings suggest the Gage is present west of the Omega site, but pinches out or disappears toward the east. The Gage Aquifer does not appear to be an important source of drinking water in the Whittier area, based on elevated total dissolved solids (TDS) concentrations observed during sampling, and none of the local water supply wells produce water from this aquifer.

Underlying the Lakewood Formation are primarily marine sand and gravels with interbedded clay, assigned to the San Pedro Formation. The San Pedro Formation reaches a maximum thickness of 850 feet and extends to a depth of about 920 feet. The San Pedro Formation unconformably underlies the Lakewood Formation. The San Pedro Formation has been subdivided into five named aquifers separated by clay members. A fine-grained layer is also typically present at the top of the sequence, although in localized areas, the uppermost San Pedro Formation aquifer may be merged with the overlying aquifer, and one or more of the five aquifers may also be merged (CDWR, 1961). This suggests that the Gage sand unit could directly overlie, and be in hydraulic connection with, San Pedro Formation aquifers in the vicinity of the Omega site. Subsurface explorations conducted near the site to date, however, have identified clays underlying the suspected Gage-equivalent sand unit. The five aquifers defined within the San Pedro Formation include, from top to bottom (shallow to deep), the Hollydale, Jefferson, Lynwood, Silverado, and Sunnyside. The upper two aquifers are less extensive and appear to be absent in the immediate vicinity of the Omega site.

The San Pedro Formation aquifers consist of varying amounts of sand and gravel with some interbedded clay. The thickness of the aquifers increases with depth. The shallow Hollydale Aquifer ranges from 10 to 25 feet, whereas the deepest Sunnyside Aquifer ranges from 200 to 300 feet. The base of the Sunnyside Aquifer reaches a maximum depth of about 1,000 feet bgs (CDWR, 1961). The San Pedro Formation aquifers are the primary source of water for the production wells in the area. The Pliocene and Miocene sediments below the San Pedro Formation generally contain saline water in the area, but locally contain freshwater (CDWR, 1961).

Based on a records search by England-Hargis (1996), there are six water supply wells within 1.5 miles of the site. The nearest well (02S/11W30-R3) also known as Santa Fe Springs Well No. 1 (SFS#1), is located 1.3 miles to the west-southwest of the former Omega Facility, at the Santa Fe Springs Fire Station on Dice Road near Burke Street. The well is screened from 200 to 288 feet bgs and from 300 to 900 feet bgs. Well SFS#1 has been constructed with screen sections that are believed to be situated in the Silverado and Sunnyside Aquifers, which occur within the lower part of the Lower Pleistocene San Pedro Formation. In several years of monitoring SFS#1, low concentrations of chlorinated volatile organic compounds (including TCE, chloroform, and PCE) have occasionally been detected, typically not exceeding state or federal drinking water levels (Maximum Contaminant Levels or MCLs). Most recently (in February 2003), only TCE, at a concentration of 0.64 microgram per liter (µg/L), was reported above the laboratory detection limit. Hexavalent chromium was reported at a concentration of 2.6 µg/L. The depth interval(s) from which the contamination is entering the well screen has not been established. The production rate of SFS#1 can be as high as 1,250 gallons per minute (gpm) (England and Hargis, 1996). It is not established what effect well SFS#1 has on local groundwater flow direction and contaminant migration. Shallow groundwater in the vicinity of the well appears to flow toward the south, unaffected by pumping from SFS#1 (Weston, 2003).

The Los Nietos water supply well (02S/11W30-Q5) is located about 1.5 miles southwest of the site (about 1,500 feet west-northwest of SFS#1). This well is screened from 152 to 370 feet bgs. PCE and TCE were detected at unknown concentrations in 1986-90 (Weston, 2003). The well locations are shown on Figure 3-1.

The remaining wells (2S/11W-29E5, 2s/11W-32G3, 2S/11W-33M1, and 2S/11W-32J4) are no longer operating, are used for irrigation, no water-quality data were available, or their exact locations are unknown (Weston, 2003).

2.4 Site Hydrogeology

The hydrogeology of the Omega site has been explored with borings and Cone Penetrometer Testing (CPT). The former Omega Chemical site is underlain by relatively low permeability silty and clayey soils, which likely correlates with the Bellflower Aquiclude, to a depth of about 120 feet bgs. A sand unit, which may correlate with the Gage Aquifer, was encountered approximately 600 feet southwest of the site beneath Putnam Street. Groundwater at OU-1 generally occurs at a depth of approximately 70 feet bgs. The depth to groundwater ranges between 40 and 70 feet over OU-2. Locally, groundwater flow appears to be generally to the southwest. Camp Dresser and McKee (CDM, 1999b) reported a local direction of groundwater flow toward the southwest with a hydraulic gradient of 0.009 foot per foot (ft/ft). TDS concentrations of greater than 3,000 milligrams per liter (mg/L) were reported in shallowest groundwater samples collected by CDM (1999b).

The hydraulic conductivity of the upper silty unit was estimated from step-drawdown tests conducted in Monitoring Well OW2 and a slug test at Monitoring Well OWl. The hydraulic conductivity in this area was found to range from 0.8 to 1.6 feet per day (CDM, 2003b). The hydraulic conductivity of the more permeable units southwest of Omega is not known.

2.5 Previous Environmental Investigations

Data obtained in 1988 from site assessment activities, including groundwater and soil sampling conducted by the site owner/operator, Dennis O'Meara, and data from a preliminary assessment conducted by EPA in January 1995 (EPA, 1995a), indicated the presence of hazardous substances in subsurface soil and groundwater at the site, including methylene chloride, PCE, and TCE. The presence of these substances and deteriorated underground storage tanks at Omega led EPA to determine that an imminent and substantial endangerment requiring a removal action existed at Omega.

On May 3, 1995, EPA issued a Unilateral Administrative Order (EPA, 1995b) authorizing a Removal Action involving the following response actions:

- Securing the site
- Sampling and categorizing hazardous materials
- Removing hazardous substances and grossly contaminated equipment, structures, and debris

- Sampling surface and subsurface soils and groundwater to determine the nature and extent of contamination
- Disposing, stabilizing or treating grossly contaminated soils
- Grading, capping, and fencing contaminated soil areas

As part of the OU-1 effort, EPA entered into a Partial Consent Decree with the PRPs who had agreed to perform work at the site (OPOG). This Partial Consent Decree was entered into the District Court on February 23, 2001. OPOG agreed to perform an RI/FS, conduct a Non-Time Critical Removal Action, perform a risk assessment, and install groundwater monitoring wells at OU-1, also referred to as the Phase 1A area.

3. Initial Evaluation

3.1 Nature of Contamination

Groundwater at the Omega site has been impacted primarily by chlorinated hydrocarbons and Freon compounds (i.e., volatile organic compounds [VOCs]). The following summary is based on the results of the Phase 2 Groundwater Characterization Study conducted by Weston Solutions, Inc. in 2003.

The five primary chlorinated compounds detected in groundwater are:

- Perchloroethene/Tetrachloroethene (PCE)
- Trichloroethene (TCE)
- 1,1-dichloroethene (1,1-DCE)
- cis-1,2-dichloroethene (cis-1,2-DCE)
- Chloroform

These are the most widespread VOCs detected in groundwater in the vicinity of the Omega site.

Eight other VOCs were locally detected in groundwater in lower concentrations. These compounds include:

- 1,2-dichloroethane (1,2-DCA)
- 1,1-dichioroethane (1,1-DCA)
- 1,1,1-trichioroethane (1,1,1-TCA)

- trans4,2-dichloroethene (trans-1,2-DCE)
- 1,2-dichioropropane
- Vinyl chloride
- Methylene chloride
- Carbon tetrachloride

Freon compounds detected at the site include:

- Trichlorofluoromethane (Freon 11)
- 1,1,2-trichloro-1,2,2-trifluoroethane; commonly referred to as trichiorotrifluoroethane (Freon 113)

As part of Weston's investigation, groundwater samples from monitoring wells were also analyzed for metals, as well as some indicators of the potential for occurrence of natural attenuation processes including total organic carbon (TOC), total Kjeldahl nitrogen (TKN), sulfate, sulfide, and methane/ethane/ethene. Of these analytes, total chromium was the most significant with respect to groundwater impacts originating from the Omega site versus other potential contamination sources. At some monitoring wells, total chromium concentrations approached or exceeded the MCL of 50 µg/L for drinking water (Weston, 2003).

CDM (1999b, 2003b) also reported relatively low concentrations of aromatic hydrocarbons (toluene, acetone, xylenes, ethylbenzene, and benzene) in samples collected from shallow wells at the former Omega Chemical Facility. Toluene and acetone concentrations of up to 900 µg/L and 6,300 µg/L, respectively, were detected in samples collected from Well OW8, located downgradient of the Omega site (CDM, 2003b).

3.2 Extent of Contamination

Figures 2-2 through 2-5 present chemical distribution maps for PCE, TCE, Freon 11, and Freon 113 in groundwater, respectively. Maps for these particular constituents of concern are presented because of their widespread distribution and reportedly higher concentrations offsite relative to the Omega site. The maps contain data from Phase 1 and Phase 2 investigations conducted by Weston Solutions, Inc. The data points include results from push-probe sampling (PP), soil borings (B), EPA monitoring wells (MW), and OPOG monitoring wells (OW). The contours are presented as drawn by Weston (2003) without modification.

As shown on Figure 2-2, the PCE plume appears to extend at least 2.2 miles downgradient west-southwest of the Omega site, with a width approaching 3/4 mile. The maximum PCE concentration reported by Weston near the site was in a groundwater sample collected from soil boring B109 (53,000 µg/L), which is located less than 500 feet west of the Omega site. Relatively higher PCE concentrations were also reported in groundwater samples collected at other borings locations in the immediate area (B108 and B110). The PCE concentrations in groundwater samples collected from borings B108 and B110 were 5,100 µg/L and 8,000 µg/L, respectively. Concentrations above 1,000 µg/L comprise about 5 percent of the area of the PCE plume as drawn by Weston, occurring primarily within approximately 2/3-mile downgradient of the Omega site. Most of the apparent PCE plume is characterized by concentrations in the range of 10 to 100 µg/L. An isolated area of relatively higher concentrations of PCE was reported at boring locations PP058 and PP066 (3,300 µg/L and 850 µg/L, respectively), indicating the likely presence of a separate source area in this region. Because the majority of the monitoring points that have been used to define the VOC plumes are based on in-situ groundwater samples from CPT borings, which sample only a very small depth interval, it is possible that some of the lateral variation in concentrations is a result of the limitations of this sampling technique. Several other areas of possible separate sources of PCE or other constituents were also identified by Weston. (Weston, 2003).

The TCE plume, as drawn by Weston (Figure 2-3), is similar in extent to the apparent PCE plume but is narrower and, overall, exhibits relatively lower concentrations. The majority of the apparent TCE plume comprises concentrations between 10 and 100 µg/L, but concentrations exceeding 100 µg/L appear to be more continuous (if less extensive) than observed for the PCE plume. The areas with the highest concentrations of TCE (greater than 1,000 µg/L) within the greater plume, occur in two apparently distinct and unconnected lobes situated near the Omega site. The narrower and smaller occurrence is nearly coincident with the estimated extent of 10,000 µg/L PCE concentrations detected immediately downgradient from the Omega site. The second area is located northwest of the Omega site. This second occurrence extends from Boring B103, with a concentration of 7,000 µg/L, at its northeastern end and continues west-southwest for approximately 3,000 feet.

The Freon 11 plume (Figure 2-4) and Freon 113 plume (Figure 2-5) as drawn by Weston are approximately one-half to two-thirds the width of the PCE and TCE plumes; however, the downgradient extent represents approximately 90 percent that of area of the TCE and PCE plumes. These apparent plumes are well bounded by groundwater sample results with detected concentrations less than 2 µg/L to the north, west, and south. The southwestern end of the Freon 113 plume encompasses an isolated area of elevated (greater than 1,000 µg/L) PCE concentrations, approximately 8,000 feet from the Omega site. The Freon 11 plume also extends to this area. The Freon concentration contours are drawn (Weston, 2003) as discontinuous (Figure 2-5), however, the data may also be interpreted as one continuous plume, similar to the Freon 113 plume.

Data indicative of the vertical distribution of contamination include groundwater samples collected from co-located monitoring wells screened at different depths and co-located direct-push samples collected at different depths. In most cases, contaminant concentrations were much lower at deeper intervals, particularly where intervening fine-grained units restricted downward migration (Weston, 2003). Almost all groundwater samples were collected from depths of about 30 to 60 feet below the first encountered water table. It is anticipated that within the known extent of the apparent VOC plume, significant contaminant concentrations in groundwater are limited to the shallow zone of approximately 30 to 60 feet below the first encountered water table. Locally, the contamination may be present in deeper, highly permeable units that serve as preferential groundwater flow pathways Also, further downgradient the contamination may migrate deeper as a result of areal recharge to the aquifer.

3.3 Potential Pathways of Contaminant Migration

CH2M Hill used an estimated contaminant migration rate when they evaluated the locations of the proposed wells at the downgradient (leading) edge of the plume. In their evaluation, CH2M Hill used the site history and estimated extent of the contamination in groundwater to provide an indication of the plume migration rate. It should be noted that this evaluation does not account for other possible sources between Omega and the downgradient edge of the plume. The Omega site started operations in 1976. Assuming a continuous release started during the first year of operations, the plume is continuous and from one source, and the downgradient edge of the plume was approximately 13,000 feet southwest from the Omega site in 2002 (26 years after start of operations at Omega) CH2M Hill estimated the average contaminant migration rate to be 500 feet per year (13,000 feet divided by 26 years). CH2M Hill stipulated that it is also possible that the contamination found in portions of the downgradient area of the plume originated entirely from sources other than the Omega site. In such a case, the contaminant migration could be slower.

The elevated VOC concentrations in the general vicinity of the intersection of Dice Road and Los Nietos Road (Figures 2-2 to 2-5) may have originated from sources other than the Omega site. Groundwater contours for February-March 2003 (Figure 2-6) and for May-June 2003 (Figure 2-7) indicate that this area is downgradient of several industrial facilities with known groundwater contamination (such as McKesson Corporation and Angeles Chemical). Production well SFS#1 is located north of the anticipated flow path from the Omega site, indicating that the low VOC concentrations occasionally observed in the well may have originated from other sites.

The advective velocity of the plume estimated by CH2M Hill will likely be revised using pumping test data obtained from the extraction well to be installed as part of the scope of work outlined in this document, as well as additional data obtained in the future.

3.4 Significant Local Ecological Features

Significant local ecological features were not identified for the OU-2.

3.5 Significant Local Cultural Features

Significant local cultural features that might be affected by the groundwater contamination beneath the OU-2 were not identified.

3.6 Significant Local Natural Resources

Significant local natural resources, other than groundwater, that might be affected by the groundwater contamination beneath the OU-2 were not identified.

3.7 Preliminary Identification of Operable Units

EPA has divided the Omega Chemical Superfund Site into two Operable Units: OU-1 and OU-2. OU-1, also known as the Phase 1a Area, includes the former Omega Chemical Facility property and extends a short distance west-southwest approximately to Putnam Street (Weston, 2003). OU-2 surrounds the Omega Chemical Facility and extends offsite at least 2.2 miles to the southwest. The exact geographical extent of OU-1 and OU-2 has not been defined. OU-1 encompasses what is considered a "source area" at the former Omega Chemical Facility property. OU-2 includes contamination in groundwater that has potentially originated from the former Omega

Chemical Facility property and potentially also from other sites. The potential other source areas are also part of OU-2.

3.8 Preliminary Identification of Response Objectives

The goals of the work to be performed in response to EPA's UAO is to better define the vertical and lateral extent of VOC-affected groundwater, as well as potentially define additional source areas for the solvent and Freon plume within the extent of OU-2.

4. Work Plan Rationale

This work plan is being prepared at the direction of the EPA, and is based on data requirements presented in CH2M Hill's SAP (July 2004). Data requirements presented in CH2M Hill's SAP will be followed. The following activities will be performed to meet those data needs, as described in CH2M Hill's SAP.

4.1 Data Quality Objective Needs

With the exception of members of the planning team and the scope of work directed, the data quality objectives (DQOs) for this project are identical to those presented in CH2M Hill's DQOs outlined in their July 2004 Quality Assurance Project Plan (QAPP), Appendix A. A copy of CH2M Hill's DQOs, extracted from Appendix A of their QAPP, is attached as Appendix A.

Members of the planning team for OSVOG are presented in Section 8 of this document. The scope of work directed by the UAO is limited to the installation of 11 groundwater monitoring wells in pre-selected locations, and the sampling of these wells.

4.2 Work Plan Approach

The approach to the work plan has been directed by the U.S. EPA in their UAO and SAP of July 2004.

5. RI Tasks

The following RI tasks will be described in this work plan: Groundwater monitoring and extraction well installation; work plan generation, groundwater monitoring well sampling and analysis, investigative-derived waste (IDW) management, report generation, and agency communication.

5.1 RI Sampling Analysis Plan

Upon approval of this RI Work Plan, ARCADIS will prepare a RI Sampling Analysis Plan (SAP). The SAP will include a Field Sampling Plan (FSP), Health and Safety Plan (HASP), and QAPP. The FSP will provide guidance for all field work by defining in detail the sampling and data gathering methods to be used on the project. Furthermore, the FSP will be developed in accordance with EPA Region IX, *Guidance for Preparation of a EPA Region IX, Field Sampling Plan for EPA-Lead Superfund Projects* (EPA, 1993).

The QAPP describes the policy, organization, functional activities, and quality assurance and quality control protocols necessary to achieve the DQOs dictated by the intended use of the data.

The HASP will be prepared in conformance with, and will incorporate by reference, ARCADIS' Health and Safety Program, and OSHA's regulations and protocols. The HASP will address employee training, health & safety risk analysis, a description of monitoring and personnel protective equipment, medical monitoring, standard operating procedures, contingency plans, and site control.

5.2 Groundwater Monitoring and Extraction Well Installation

During the remedial investigation, 11 monitoring wells or clusters and one extraction well will be installed to further characterize the nature and extent of contamination and to characterize the site hydrogeology. The new groundwater wells will be installed to:

- Further characterize the vertical and lateral extent of contaminant distribution in groundwater within the OU-2 study area, and better define the contaminant distribution within the plume.
- Investigate the potential presence of emerging contaminants.
- Further define aquifer stratigraphy and estimate aquifer hydraulic properties from aquifer tests and slug tests.
- Better define groundwater flow direction in the downgradient portion of the plume.
- Assess vertical flow gradients and provide permanent monitoring points for measuring groundwater elevations.

- Provide permanent monitoring points for others to track contamination in the downgradient plume area and contaminant distribution within the plume.

The purpose of the proposed well locations along the perimeter of the plume is to define its lateral extent. The proposed well locations were based on the perceived distribution of the plume in 2003. With the understanding that the plume is likely to have migrated further southwest, ARCADIS will evaluate screening the groundwater quality in the proposed well locations along the plume perimeter by collecting grab samples using a cone penetrometer test (CPT) rig, as discussed with the EPA on October 26, 2004.

Monitoring wells constructed for the OU-2 investigation will be drilled using one or more of the following methods: hollow-stem auger (HSA) drilling method, air-rotary/casing-hammer (ARCH) method, sonic drilling method, or the mud-rotary method. The shallow and intermediate monitoring wells will be drilled using the dual-tube, ARCH, or sonic methods. Drilling mud may be used during construction of the deeper monitoring wells or where collapsing of the borehole is encountered during drilling of the shallow and intermediate wells or where heaving sand is encountered. Each drilling method is briefly described below. The determination of which drilling method to use will be made based on the overall technical approach and cost of subcontractor bids. A detailed description of these drilling methods will be presented in the SAP.

5.2.1 Rationale for Proposed Groundwater Monitoring Well Locations and Construction

Currently, the locations of the proposed groundwater monitoring wells are based on recommendations by CH2M Hill in their *Field Sampling Plan for Omega Chemical Superfund Site, Operable Unit 2, Remedial Investigation/Feasibility Study, July 2004,* described below. ARCADIS may, upon further evaluation of existing data regarding contaminant distribution and potential downgradient off-site sources, recommend alternative well locations and construction from those specified in the CH2M Hill SAP.

Eleven monitoring wells or well clusters (PMW12 to PMW22) and one extraction well (PEW1) are proposed for construction in the OU-2 study area. Figure 3-1 shows the locations of the proposed wells and screen depths, as well as the locations of existing EPA and OPOG monitoring wells. The proposed wells are also shown on the PCE, TCE, Freon 11, and Freon 113 plume maps (Figures 2-2 through 2-5). The proposed well names start with "PMW" and continue with a sequential number (e.g., PMW15). They are numbered sequentially from east to west, not in the order in which they will be installed (the installation of some of the wells will be postponed, as discussed below). Once installed, the wells will be numbered in a sequence with the existing wells in the order of installation (i.e., starting with MW12).

A combination of single-screen monitoring wells and well clusters, is proposed. Well clusters will allow monitoring of heads and contaminant concentrations at different depth zones. In the downgradient area of the plume, well clusters are also more likely to intercept contamination that may have spread over a greater extent and depth in the aquifer compared to locations closer to the source. The well clusters will be installed as multi- completion wells within one or two borings. Two three-well clusters are proposed.

Single-screen wells will be installed at the remaining locations. The well screen intervals will be selected based on the results of discrete-depth groundwater sampling during drilling; the depth interval with the highest contaminant concentration will be screened. If discrete- depth sampling results indicate that groundwater contamination extends over more than one permeable unit, a well cluster will be installed at that location instead of a single well.

As shown on Figure 2-2, proposed monitoring well clusters PMW17 and PMW2O are situated along the suspected axis of the PCE contaminant plume in the downgradient area. Well PMW17 is proposed downgradient of a high-concentration area exceeding 1,000 µg/L that is located approximately 8,000 feet downgradient of the Omega site and approximately two-thirds of the distance to the leading edge of the plume. A cluster of two to three wells is proposed here instead of a single well to allow monitoring of heads (to assess vertical flow gradients) and contaminant concentrations in groundwater at different depths. Well PMW20 is situated close to the anticipated leading edge of the plume. A cluster of wells, instead of a single well, is proposed at this location because the depth interval of the contaminated aquifer is expected to increase with distance from the source area(s). A well cluster will allow for monitoring of contaminant concentrations and heads at different depths. A well cluster is also more likely to intercept contamination that may migrate to this location at a later time than a single well.

Proposed monitoring wells PMW18, PMW19, PMW21, and PMW22 are situated near the suspected leading edge of the contaminant plume and will assist in characterizing the lateral extent of contamination downgradient of the Omega Site. Installation of these wells will also provide additional information on groundwater elevations and aquifer stratigraphy. These wells are proposed in areas of expected low concentrations. The proposed well locations may be modified based on the results of the investigation (cluster wells PMW17 and PMW2O will be installed before the leading-edge wells). The downgradient extent of the contamination as shown on Figures 2-2 to 2-5 is unknown because no data are available from the downgradient area. Preferably, the new downgradient wells would be installed in a zone where contaminant concentrations range between non-detects (NDs) and MCLs to characterize the plume leading edge. If contaminant concentrations detected in groundwater samples from wells PMW18, PMW19, PMW21, and PMW22 exceed MCLs, approximately three additional wells will need to be installed farther downgradient.

Well PMW16 is situated along the axis of the plume, upgradient of the greater than 1,000 :g/L hot spot located in the vicinity of Los Nietos Road and Pacific Street, where potential sources of contamination other than the Omega site may be present. This well will be installed to characterize the distribution of contamination within the plume. There is an apparent low-concentration zone at this location (Figure 2-2 PCE), and a high-concentration zone just downgradient, as characterized by a former direct-push investigation. This well will verify the continuity of the plume. The installation of this well will be postponed until after an investigation of the source areas.

Well PMW15 is situated in an apparent high-concentration area approximately 3,000 feet downgradient of the Omega site and will verify the plume continuity. The installation of this well will be postponed until after an investigation of the source areas.

Well PMW14 is proposed in a high-concentration area of the plume, approximately 1,700 feet downgradient of the Omega site, to verify the plume continuity, vertical contaminant distribution, and to characterize the stratigraphy downgradient of the Omega site.

Well PMW12 is proposed approximately 1,100 feet north-northwest of the Omega site in an area of contamination that likely originated from another source. The installation of this well will be postponed until after an investigation of the source areas.

Well PMW13 is proposed approximately 800 feet west-northwest of the Omega site in an area of contamination that may have originated from the Omega site and/or another source. This well will provide information on the aquifer stratigraphy as well as contaminant distribution. The installation of this well will be postponed until after an investigation of the source areas. The contaminant concentration distribution in this area is uncertain; it is largely known from direct-push sampling only. Another well may need to be installed in this area.

Extraction well PEW-1 is proposed to be constructed just south of the existing MW8 well cluster. The extraction well will serve as a pumping well for an aquifer test (not in this scope of work) that will be conducted to estimate aquifer hydraulic properties in this area. This location was selected because it is downgradient of a zone of high contaminant concentrations and is interpreted to be within a highly permeable, laterally extensive zone that provides a preferential contaminant transport pathway from the Omega site. The contaminant concentrations detected in samples from the MW8 well cluster decreased with depth (PCE and TCE concentrations of 580 and 120 μg/L in the top screen interval MWO8A decreased to 14 and 3 μg/L in MW08B, respectively), indicating that the top screen interval intercepts the main contaminant transport pathway (Weston, 2003). The test will assess the hydraulic communication between the contaminated shallow aquifer and the relatively clean deeper aquifer and will provide estimates of hydraulic properties of the shallow aquifer. The deeper screens of Well MWO8 are believed to have intercepted regional aquifers (starting with Gage and Hollydale Aquifers from the top) that could potentially become major contaminant transport pathways (Weston, 2003). Pumping from the less contaminated zone will also allow onsite treatment of the extracted groundwater.

The new wells will be installed in two phases. Wells PMW14, PMW17, PMW18, PMW19, PMW2O, PMW21, and PMW22 will be installed first to characterize the extent of the contamination, aquifer lithology, and groundwater flow patterns. The installation of wells PMW12, PMW13, PMW15, and PMW16 will be postponed to consider the results of the first phase and also the results of the investigation of the potential source areas other than the former Omega Chemical Corporation site. The proposed locations for the second-phase wells are tentative and will likely be revised based on the new information. Additional wells for characterizing the plume leading edge will be installed during the second phase of drilling, if necessary.

5.2.2 Plans for Securing Permits and Right-of-Access Agreements

Permits will be obtained from the Los Angeles County Department of Health Services – Mountain and Rural Program for construction of the wells. The City of Whittier is an OSVOG member, and has agreed to arrange for access to the Group for those well locations located in the public right of way in the City of Whittier and to expedite necessary permits from the City of Whittier. Whittier has a good working relationship with its adjoining neighbor, Santa Fe Springs, and has agreed to assist the Group in working with Santa Fe Springs to expedite permitting and access to the proposed well locations in the Santa Fe Springs right of way.

OSVOG will work to obtain access agreements and rights-of-way permits for the various individuals/organizations that privately own property as well on which wells are proposed. If individual property owners are uncooperative in providing access, ARCADIS will attempt to identify alternate locations (acceptable to EPA) within city rights of way to further simplify the permitting process. The permits will allow access for the installation of wells, as well as future groundwater monitoring of the wells.

5.2.3 Utility Clearance

Before drilling, the presence of underground utilities will be verified by Underground Service Alert (USA). A geophysical contractor will be called to survey drilling locations for which USA does not provide service. In addition, each boring will be started with a hand-auger or an air-knife to a depth of at least 5 feet to uncover any unknown or undetected utilities.

5.2.4 Soil Sampling and Logging

Borehole drill cuttings will be collected every 10 feet or at changes in soil material for descriptive and monitoring purposes until groundwater is encountered. Continuous samples will then be collected (for descriptive purposes) until total depth is reached. Samples will be collected, logged and described by the field geologist and screened for organic contaminants with a photoionization detector. Following completion of the borings, samples will be disposed of with the rest of the drill cuttings. Downhole soil samples will not be collected for laboratory analysis. Descriptions of materials encountered during drilling procedures will be supplemented by geophysical logging data described in Section 5.2.6 of this document.

5.2.5 Depth Discrete Water Sampling

In situ, depth-profile samples will be collected during drilling. It is anticipated that the boring will be advanced approximately 50 feet into the saturated zone and samples taken about every 10 feet beginning at the first encountered groundwater table (approximately 30 to 70 feet bgs). These sample depths are tentative; actual sample depths will be selected based on encountered stratigraphy with the goal of sampling permeable (coarse grained) units. The total anticipated boring depth will be 150 feet bgs or less. At the plume-perimeter well locations, where ARCADIS proposes to screen the water quality using a CPT rig, depth-profile samples will be collected at 10-foot intervals, where possible, via the CPT drive rods. Should the total target depth not be reached using the CPT rig, additional samples will be collected while drilling with the chosen drill rig.

For planning purposes, it is assumed that 5 in situ groundwater samples will be collected at each well, for a total of 55 environmental field samples (not including duplicates, blanks, and QC samples). Samples will be analyzed for VOCs (the primary contaminants of concern), as discussed in Section 4. The sample results will need to be available in time for determining the well construction; an onsite mobile laboratory will be required.

In situ groundwater samples will be collected during drilling of the intermediate wells, beginning at the water table and extending every 10 to 20 feet to the total depth of the well. Additional samples may be collected at the discretion of the onsite geologist, with the intention to sample saturated sand horizons. For planning purposes, five groundwater samples are assumed for each well. Discrete-depth sampling is not anticipated during drilling of the extraction well (PEW1). A detailed description of the methods to be used for depth-discrete water sampling will be presented in the SAP.

5.2.6 Geophysical Logging

In the event that mud-rotary is used to advance the borings, boreholes will be geophysically logged immediately upon completion of the pilot hole for each well. Results from the geophysical logging will help determine the casing depth and well screen interval. Geophysical logs to be performed will include electrical resistivity (long and short normal) and spontaneous potential. Additional logs such as caliper or natural gamma ray may be conducted if deemed necessary. Once the screened interval is determined, the mud weight will be cut and the well casing and filter pack installed. The well will then be surged to settle the filter pack prior to installing the annular seal.

Dual-tube or ARCH boreholes cannot be geophysically logged prior to well installation. Wells installed in boreholes drilled by these methods may be logged using the induction and natural gamma methods, if deemed necessary. For the induction logging to be meaningful, the wells would have to be constructed entirely using polyvinyl chloride (PVC).

5.2.7 Elevation Control

Ground surface and top-of-casing elevation, as well as the latitude and longitude of each of the wells to be installed will be determined by a qualified surveying subcontractor licensed in the State of California.

5.2.8 Well Development

Monitoring wells will be developed prior to groundwater sampling in accordance with the State of California Well Standards, Bulletins 74-81 and 74-90. A detailed description of well development procedures will be presented in the SAP.

5.3 Groundwater Monitoring Well Sampling and Analysis

Following development, the new (OSVOG) groundwater monitoring wells installed under the first amended UAO will be sampled in accordance with the specifications outlined in the June 25, 2004 Statement of Work for Remediation Investigation Field Activities (SOW) attached to the UAO. As indicated in the UAO SOW, OSVOG will conduct only one sampling event.

Analysis of VOCs with low-detection limits will be used to assess the magnitude of groundwater contamination in the new monitoring wells and to determine whether any of the VOCs detected exceed regulatory limits. The rationale for the VOC analyses is that VOCs are the most prevalent contaminants known to have originated from the Omega site. Sampling for VOCs will be included in all sampling events. Sampling for metals, semi-volatile organic compounds (SVOCs), NDMA, perchlorate, 1,4-dioxane, 1,2,3-trichloroepropane (1,2,3-TCP), and hexavalent chromium will be conducted to evaluate exceedances of regulatory limits and to assess the need for continued monitoring or future treatment for these analytes. The rationale for these analyses is that many of the compounds have state or federal MCLs, California action levels, or other regulatory limits, and have been detected in areas of OU-2 where VOCs are present. They also require significantly different treatment methods for removal from groundwater compared to VOCs. Remedial action at OU-2 will have to address these compounds in addition to VOCs.

5.4 IDW Management

The types of wastes that may be derived from the RI field activities include drill cuttings and drilling fluids from drilling activities, water from developing and purging monitoring wells before sampling, protective clothing, and trace amounts of decontamination rinsate.

A detailed description of IDW Management will be presented in the RI Sampling and Analysis Plan that will be prepared and submitted under separate cover.

5.5 Report Generation

ARCADIS will prepare a Project Completion Report describing the procedures and results of the remedial investigation directed under the UAO SOW. In addition, the report will evaluate the usefulness and completeness of the data and objectives, respectively. An outline of the Project Completion Report is provided below.

1.0 Introduction – Purpose of the report, report organization, and site background

2.0 Background Information – site location, local geology and hydrogeology, site-specific geology and hydrogeology, site history, previous investigations.

3.0 Study Area Investigation – Summary of field activities, including previous technical memoranda, weekly reports, boring logs, and final approved well construction drawings.

4.0 Presentation of the Data – A description of the physical and chemical results of the field activities, including any newly identified surface features, geology, soils and hydrogeology of the study area. Results of groundwater monitoring, including contaminants of concern, vertical and lateral extent of contamination will be discussed.

5.0 Data Evaluation – a discussion of the usefulness and completeness of the data will be discussed in this section

6.0 Summary

7.0 Recommendations

8.0 References

5.6 Agency Communication

Weekly reports to the OSVOG team and EPA (via Project Navigator) will be provided once approval of the SAP and QAPP are issued.

6. Costs and Key Assumptions

Key assumptions used to evaluate the cost to perform this SOW will be forwarded upon completion.

7. Schedule

The schedule for the SOW outlined in this work plan is presented in Appendix B.

8. Project Management

This work is being performed on behalf of the OSVOG. OSVOG is being represented by Mr. Peter McGaw of the Law Offices of Archer Norris. Mr. Ken Fredianelli of Project Navigator will be the Project Coordinator (PC), communicating with EPA's Remedial Project Manager (EPA RPM), Mr. Christopher Lichens, Mr. McGaw, and ARCADIS' Project Manager (PM), Mr. John Johnsen.

8.1 Organization and Staffing

ARCADIS' team is headed by Mr. John Johnsen. The PM will manage the financial, schedule, and technical status of the work assignment. Key people involved in interfacing with the PM are the PC, individual task managers, and members of the quality assurance team (QAT). Project organization and the line of authority for ARCADIS' efforts are illustrated in the organizational chart attached in Appendix C.

8.2 Coordination

The primary responsibility for project quality rests with the Project Management. Independent quality control (QC) is provided by the QAT. The QAT will review project planning documents, data evaluation, and deliverables. Outside organizations may be used to evaluate the quality of laboratory data.

The sampling team will implement the QAPP, FSP, and the HASP. The site safety coordinator (SSC) is responsible for adherence to the HASP and field decontamination procedures. The entire effort is directed by the Field Team Leader (FTL).

The subcontract administrator is responsible for procuring subcontracts, and will interface with subcontractors. Subcontractors likely to be used in implementing this work plan include drillers, chemical and physical analytical laboratories, surveyors, waste disposal contractors, and laboratory data evaluators.

Where quality assurance problems or deficiencies requiring special action are uncovered, the PM and QAT will identify the appropriate corrective action to be initiated by the PM or the laboratory.

9. References

Camp Dresser and McKee. 1999a. Groundwater Data Evaluation Report, Waste Disposal, Inc. Superfund Site, Santa Fe Springs, California. January 14.

Camp Dresser and McKee. 1999b. Draft Phase la Pre-Design Field Investigation Report, Omega Chemical Superfund Site. October 13.

Camp Dresser and McKee. 2003a. Final On-Site Soils Remedial Investigation/Feasibility Study Work Plan. September 29.

Camp Dresser and McKee. 2003b. Draft Report Addendum for Additional Data Collection in the Phase 1A Area, Omega Chemical Superfund Site, Whittier, California. June 27.

California Department of Water Resources. 1961. Bulletin 104. Planned Utilization of the Ground Water Basins of the Coastal Plain of Los Angeles County Appendix A Groundwater Geology.

CH2M Hill, 2004. Sampling and Analysis Plan, July 2004.

England & Associates and Hargis and Associates, Inc. 1996. Phase II Close Out Report, Omega Chemical Site. October 1.

EPA. 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA.

EPA. 1993. Guidance for Preparation of a USEPA Region IX, Field Sampling Plan for EPA-Lead Superfund Projects.

EPA. 1995a. Preliminary Assessment for Omega Chemical Corporation Site, Whittier, California. January.

EPA. 1995b. Unilateral Administrative Order, Docket Number 95-15. Issued to Omega Chemical Corporation and Respondents. Whittier, California. May.

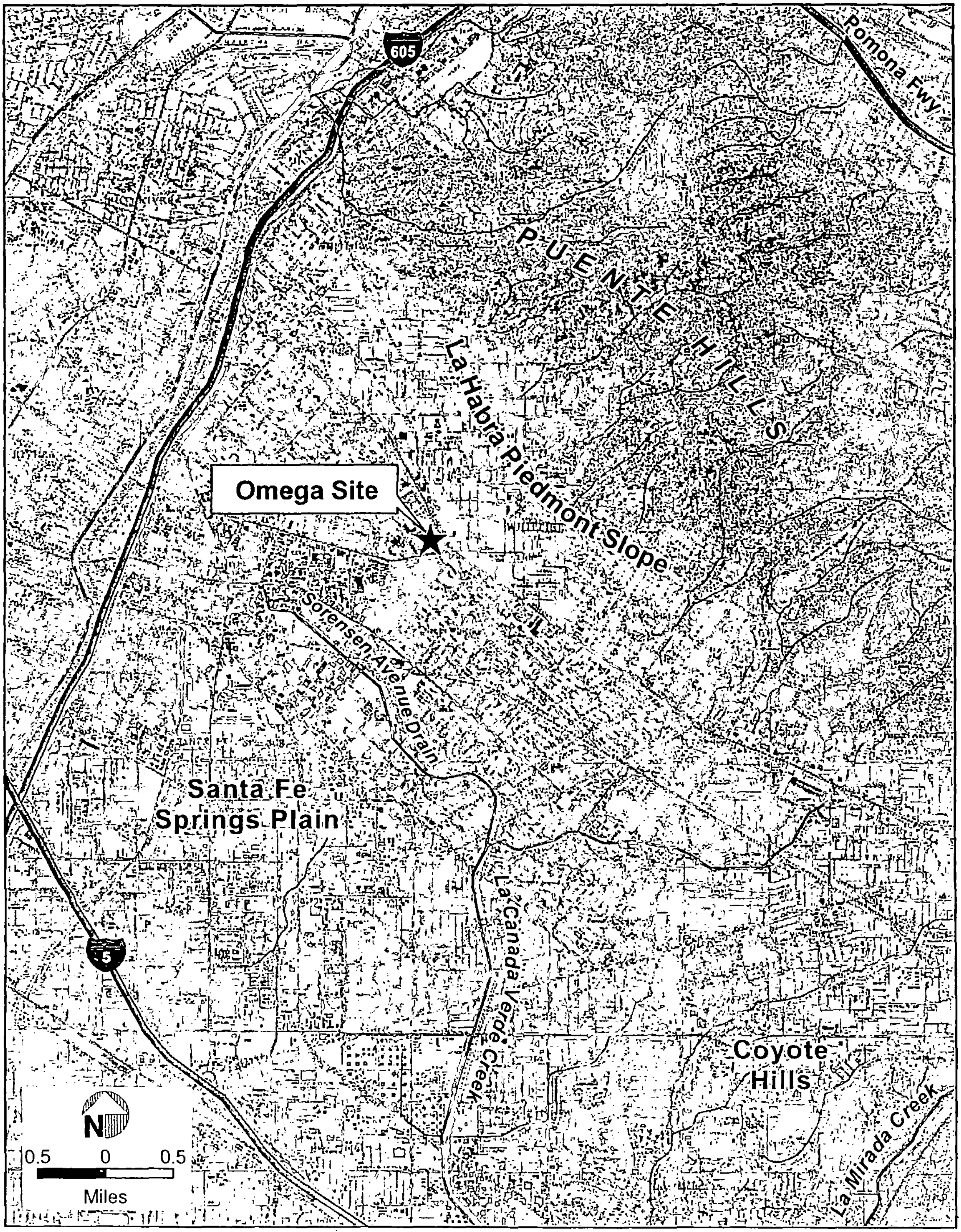
EPA, 2001. Partial Consent Decree.

USEPA, see EPA.

Weston Solutions, Inc., 2003. Omega Chemical Superfund Site Whittier California Phase 2 Groundwater Characterization Study. June 2003.

ARCADIS

Figures



SOURCE: CHRM HILL, INC. FIGURE 1-1 SITE LOCATION MAP

Area Manager: K. THOMAS	ARCADIS	SITE LOCATION MAP	Project Number: CA646.01.01
Project Director: J. FRIEDMAN			Drawing Date: 9/7/04
Task Manager: R. HALPERN	Arcadis of Los Angeles 1400 N. Harbor Boulevard, Suite 700 Fullerton, CA 92835-4127 Tel: 714-278-0992 Fax: 714-278-0051 www.arcadis-us.com	OMEGA CHEMICAL SUPERFUND SITE WHITTIER, CALIFORNIA	Figure: 1-1
Technical Review: R. HALPERN			

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System	Series	Formation	Aquifer and Aquiclude	Thickness (feet)
QUATERNARY	RECENT	ALLUVIUM	BELLFLOWER AQUICLUDE	10-40
			GASPUR	0-30
	UPPER PLEISTOCENE	LAKEWOOD FORMATION	BELLFLOWER AQUICLUDE	10-40
			ARTESIA	0-40
			GAGE	0-30
	UNCONFORMITY			
	LOWER PLEISTOCENE	SAN PEDRO FORMATION	HOLLYDALE	0-40
			JEFFERSON	20-40
			LYNWOOD	50-100
			SILVERADO	100-300
			SUNNYSIDE	200-300
	LOCAL UNCONFORMITY			
TERTIARY	UPPER PLIOCENE	PICO FORMATION	UNDIFFERENTIATED	

SOURCE: CH2M HILL, INC. FIGURE 2-1 GENERALIZED STATIGRAPHIC COLUMN

Area Manager: K. THOMAS Project Director: J. FRIEDMAN Task Manager: R. HALPERN Technical Review: R. HALPERN	ARCADIS Arcadis of Los Angeles *1400 N. Harbor Boulevard, Suite 700* Fullerton, CA 92835-4127 Tel: 714-278-0992 Fax: 714-278-0051 www.arcadis-us.com	GENERALIZED STATIGRAPHIC COLUMN FOR THE WHITTIER AREA (BASED ON DATA FROM CDWR, 1961) OMEGA CHEMICAL SUPERFUND SITE WHITTIER, CALIFORNIA	Project Number: CA646.01.01 Drawing Date: 9/7/04 Figure: 2-1

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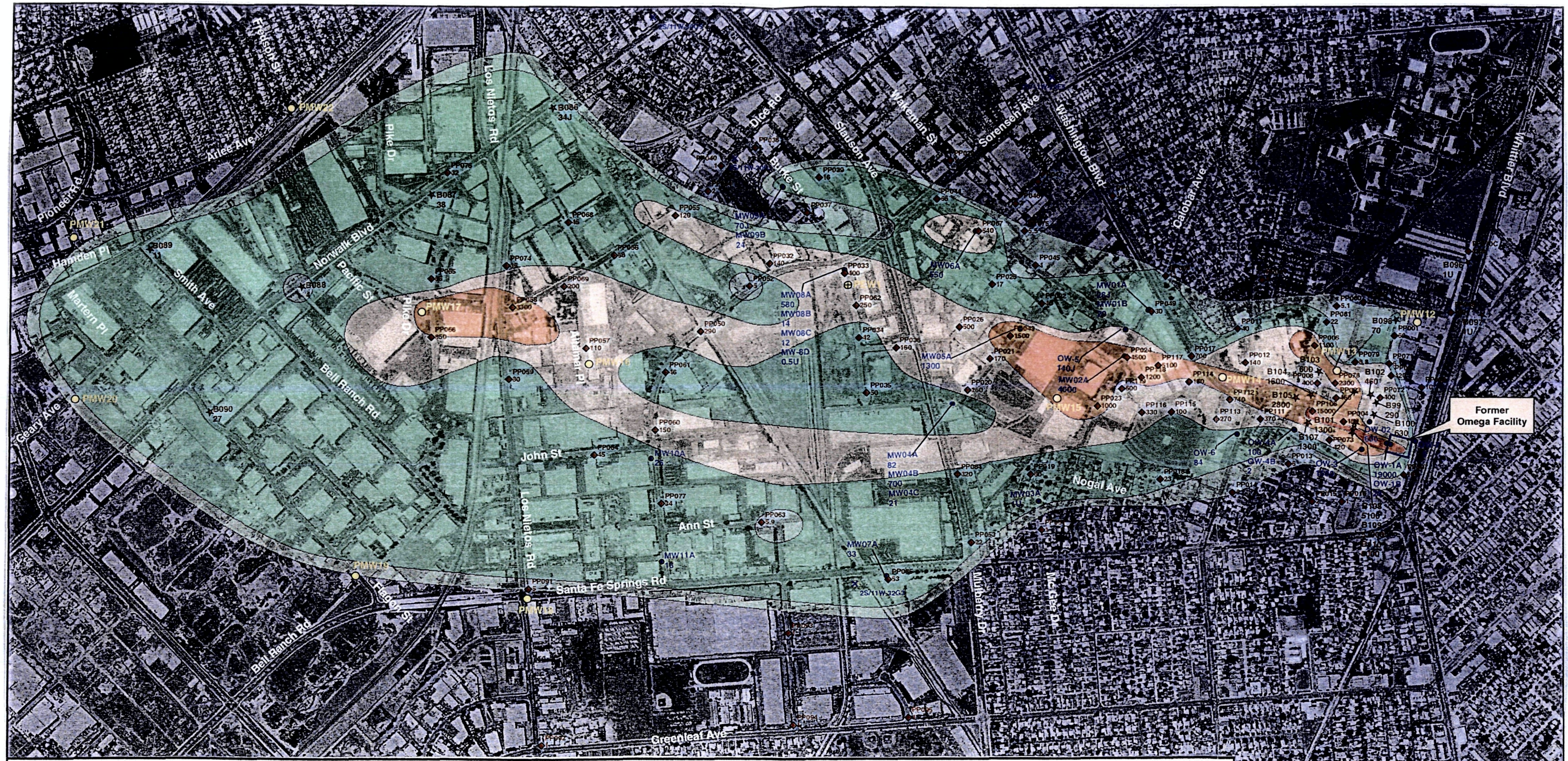

Legend

Wells

- Production Well
- Monitoring Well
- Proposed Extraction Well
- Proposed Monitoring Well

MW08A = Station Name
580 = Concentration Value

Hydropunch

- CPT Boring
- Auger Boring

PP062 = Station Name
250 = Concentration Value

Former Omega Facility

PCE Concentration (ug/L)

5
10
100
1000
10000

0 500 1,000 Feet

PCE Concentrations Contours from Weston, 2003

SOURCE: CH2M HILL, INC. FIGURE 2-2 PCE CONCENTRATIONS IN GROUNDWATER

Area Manager: K. THOMAS	ARCADIS	PCE CONCENTRATIONS IN GROUNDWATER	Project Number: CA646.01.01
Project Director: J. FRIEDMAN			Drawing Date: 9/7/04
Task Manager: R. HALPERN	Arcadis of Los Angeles 1400 N. Harbor Boulevard, Suite 700 Fullerton, CA 92835-4127 Tel: 714-278-0992 Fax: 714-278-0051 www.arcadis-us.com	OMEGA CHEMICAL SUPERFUND SITE WHITTIER, CALIFORNIA	Figure: 2-2
Technical Review: R. HALPERN			

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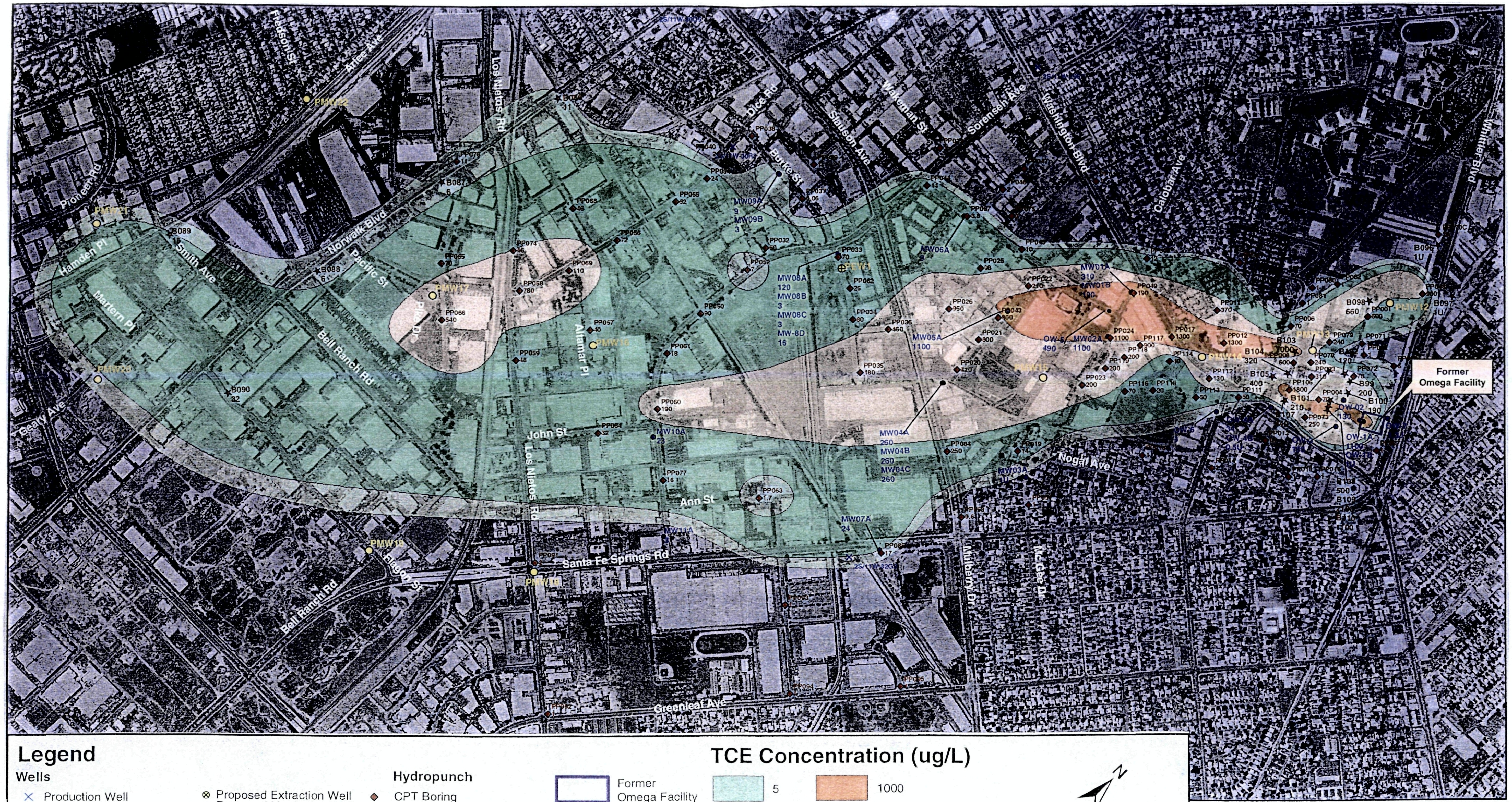

Legend

Wells

- Production Well
- Monitoring Well
- Proposed Extraction Well
- Proposed Monitoring Well

MW08A = Station Name
120 = Concentration Value

Hydropunch

- CPT Boring
- Auger Boring

PP062 = Station Name
25 = Concentration Value

Former Omega Facility

TCE Concentration (ug/L)

5
10
100
1000
10000

0 500 1,000 Feet

TCE Concentrations Contours from Weston, 2003

SOURCE: CH2M HILL, INC. FIGURE 2-3 TCE CONCENTRATIONS IN GROUNDWATER

Area Manager	K. THOMAS
Project Director	J. FRIEDMAN
Task Manager	R. HALPERN
Technical Review	R. HALPERN

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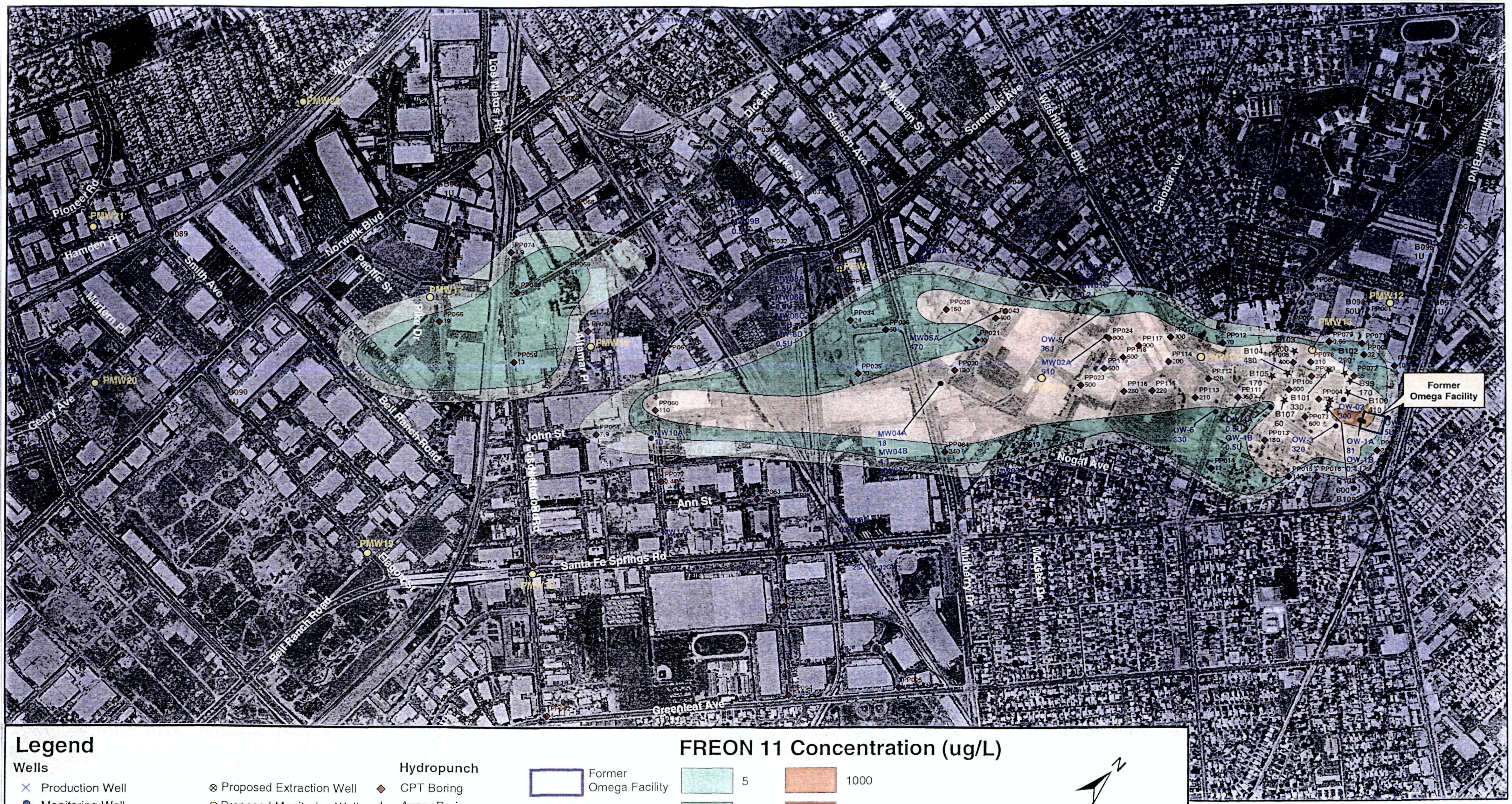
TCE CONCENTRATIONS IN GROUNDWATER

OMEGA CHEMICAL SUPERFUND SITE
WHITTIER, CALIFORNIA

Project Number: CA646.01.01
Drawing Date: 9/7/04
Figure: 2-3



Legend

Wells

- ✕ Production Well
- ● Monitoring Well
- ⊗ Proposed Extraction Well
- ○ Proposed Monitoring Well

MW08A = Station Name
.5U = Concentration Value

Hydropunch

- ◆ CPT Boring
- ★ Auger Boring

PP062 = Station Name
0.5 = Concentration Value

▭ Former Omega Facility

FREON 11 Concentration (ug/L)

5
10
100
1000
10000

0 500 1,000 Feet

FREON 11 Concentrations Contours from Weston, 2003

SOURCE: CH2M HILL, INC. FIGURE 2-4 FREON 11 CONCENTRATIONS IN GROUNDWATER

Area Manager	K. THOMAS
Project Director	J. FRIEDMAN
Task Manager	R. HALPERN
Technical Review	R. HALPERN

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FREON 11 CONCENTRATIONS IN GROUNDWATER

OMEGA CHEMICAL SUPERFUND SITE
WHITTIER, CALIFORNIA

Project Number	CA646.01.01
Drawing Date	9/7/04
Figure	2-4

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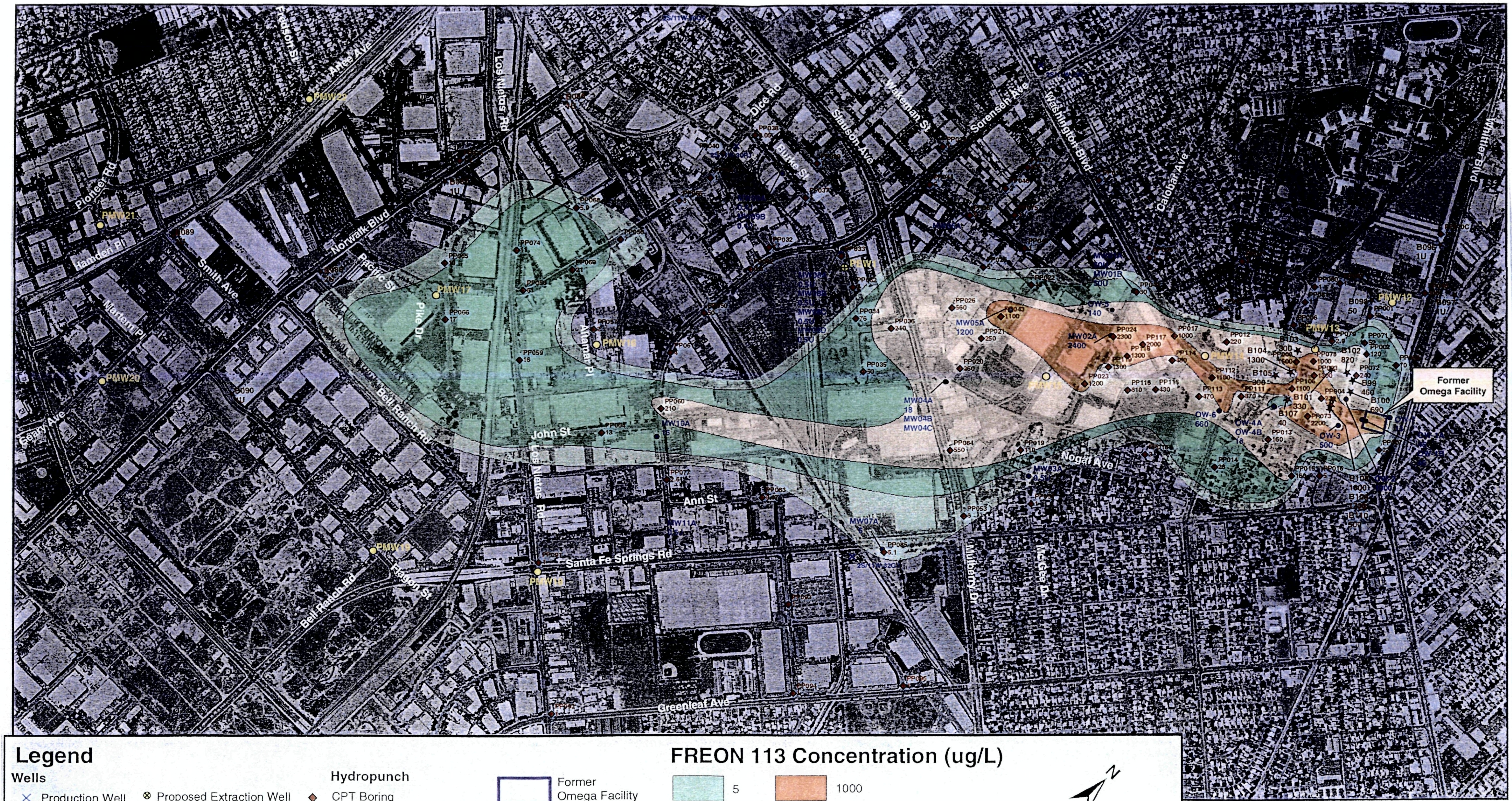

Legend

Wells

- × Production Well
- ● Monitoring Well
- ⊗ Proposed Extraction Well
- ○ Proposed Monitoring Well

Hydropunch

- ◆ CPT Boring
- ★ Auger Boring

PP062 = Station Name
0.5 = Concentration Value

Former Omega Facility

FREON 113 Concentration (ug/L)

- 5
- 10
- 100
- 1000
- 10000

N

0 500 1,000 Feet

FREON 113 Concentrations Contours from Weston, 2003

SOURCE: CH2M HILL, INC. FIGURE 2-5 FREON 113 CONCENTRATIONS IN GROUNDWATER

Area Manager	K. THOMAS
Project Director	J. FRIEDMAN
Task Manager	R. HALPERN
Technical Review	R. HALPERN

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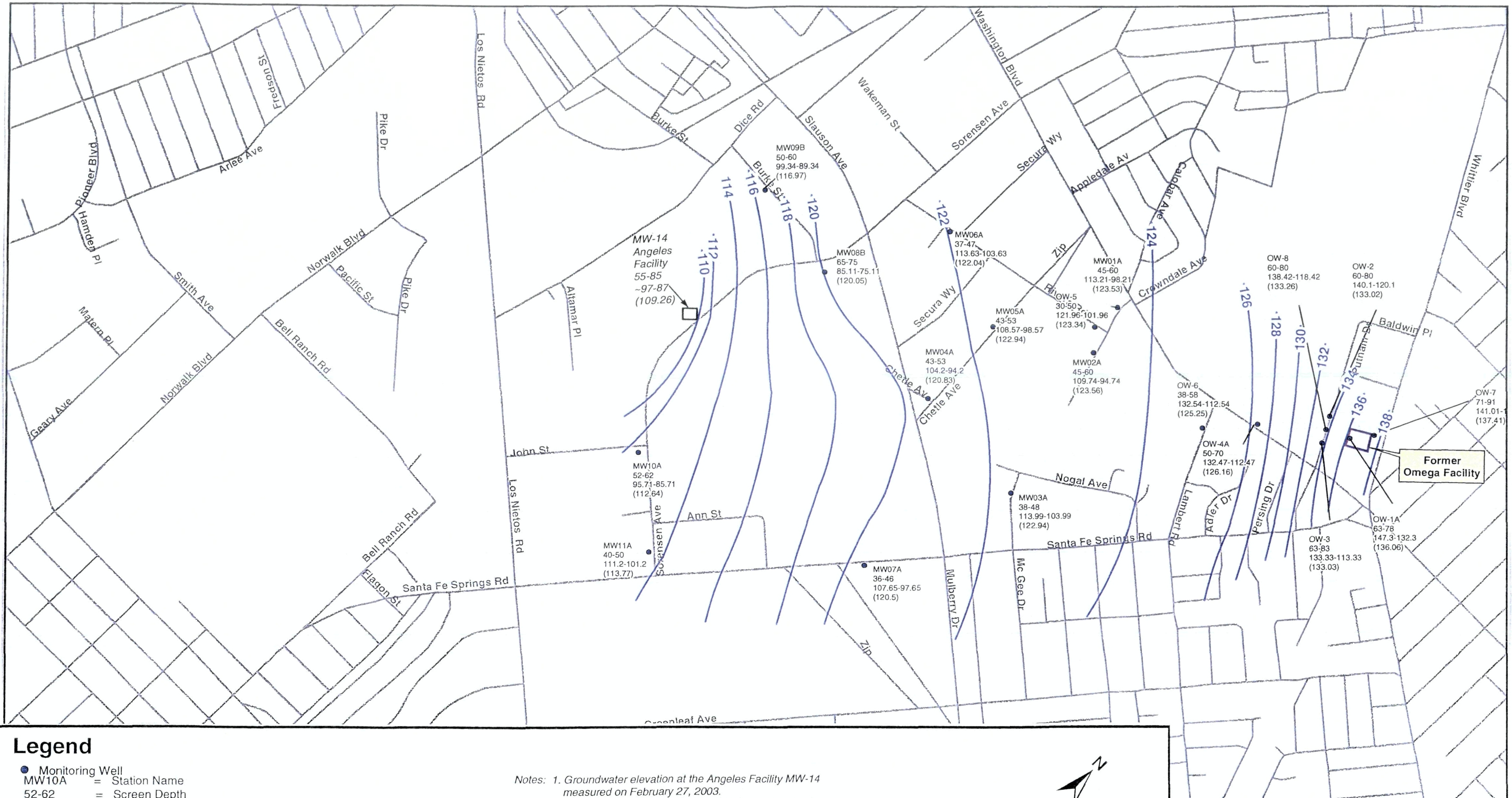
FREON 113 CONCENTRATIONS IN GROUNDWATER

OMEGA CHEMICAL SUPERFUND SITE
WHITTIER, CALIFORNIA

Project Number: CA646.01.01
Drawing Date: 9/7/04
Figure: 2-5



Legend

● Monitoring Well

MW10A	=	Station Name
52-62	=	Screen Depth
95.71-85.71	=	Screen Elevation
(112.64)	=	Groundwater Elevation

▭ Former Omega Facility

Notes: 1. Groundwater elevation at the Angeles Facility MW-14 measured on February 27, 2003.
2. OPOG and OU-2 groundwater elevations measured between February 19 and March 3, 2003.

N

0 500 1,000 Feet

SOURCE: CH2M HILL, INC. FIGURE 2-6 GROUNDWATER CONTOUR FEBRUARY - MARCH 2003

Area Manager: K. THOMAS	ARCADIS	GROUNDWATER CONTOURS FEBRUARY - MARCH 2003	Project Number: CA646.01.01
Project Director: J. FRIEDMAN	Arcadis of Los Angeles, 1400 N. Harbor Boulevard, Suite 700, Fullerton, CA 92835-4127, Tel: 714-278-0992 Fax: 714-278-0051, www.arcadis-us.com	OMEGA CHEMICAL SUPERFUND SITE, WHITTIER, CALIFORNIA	Drawing Date: 9/7/04
Task Manager: R. HALPERN			Figure: 2-6
Technical Review: R. HALPERN			

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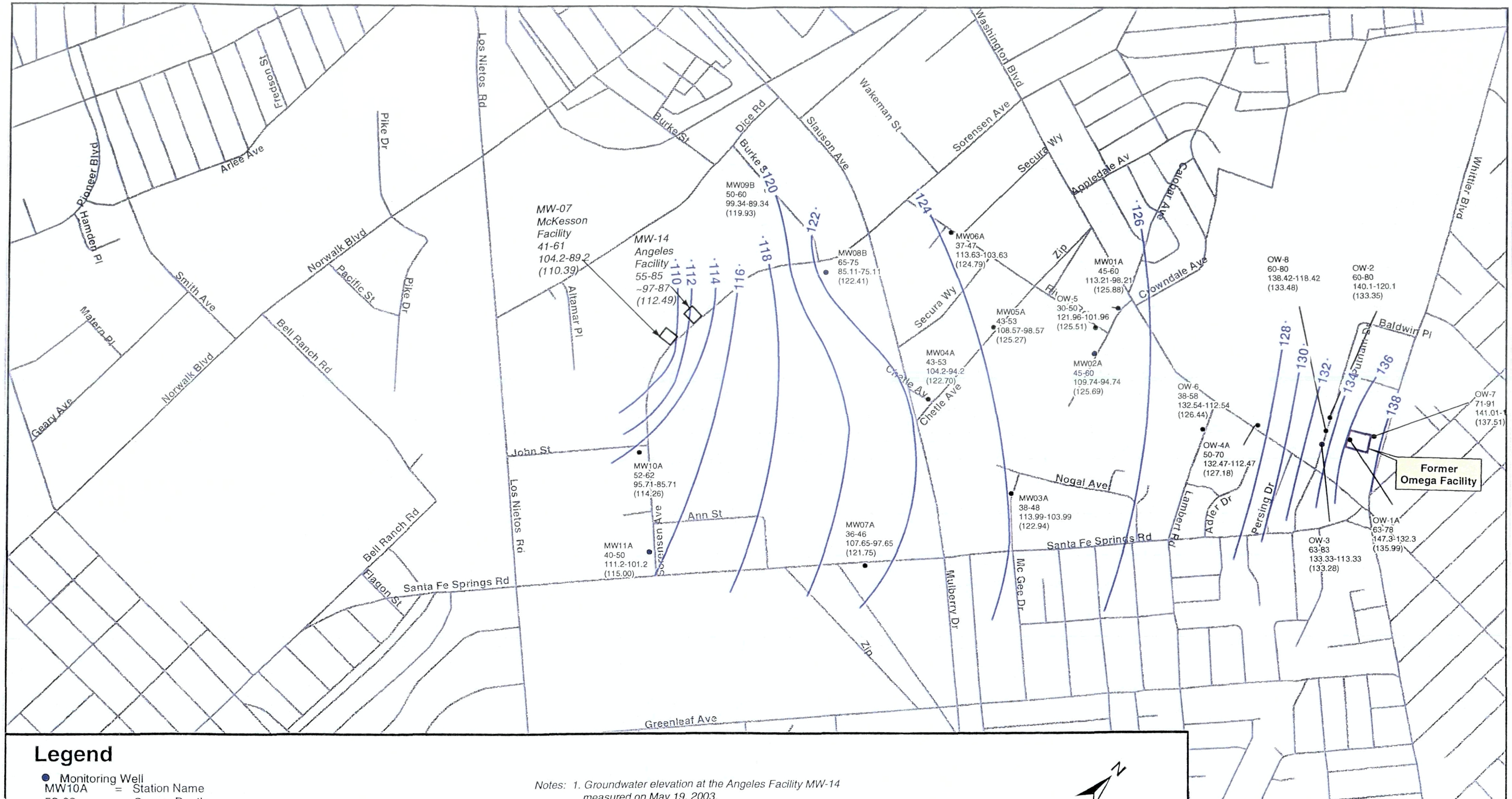

Legend

- Monitoring Well

MW10A = Station Name
52-62 = Screen Depth
95.71-85.71 = Screen Elevation
(114.26) = Groundwater Elevation

Former Omega Facility

Notes:
1. Groundwater elevation at the Angeles Facility MW-14 measured on May 19, 2003.
2. Groundwater elevation at the McKesson Facility MW-07 measured on June 9, 2003.
3. OPOG and OU-2 groundwater elevations measured between May 13 and May 21, 2003.

N

0 500 1,000
Feet

SOURCE: CH2M HILL, INC. FIGURE 2-7 GROUNDWATER CONTOUR MAY - JUNE 2003

Area Manager	K. THOMAS
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GROUNDWATER CONTOURS MAY - JUNE 2003

OMEGA CHEMICAL SUPERFUND SITE
WHITTIER, CALIFORNIA

Project Number: CA646.01.01
Drawing Date: 9/7/04
Figure: 2-7

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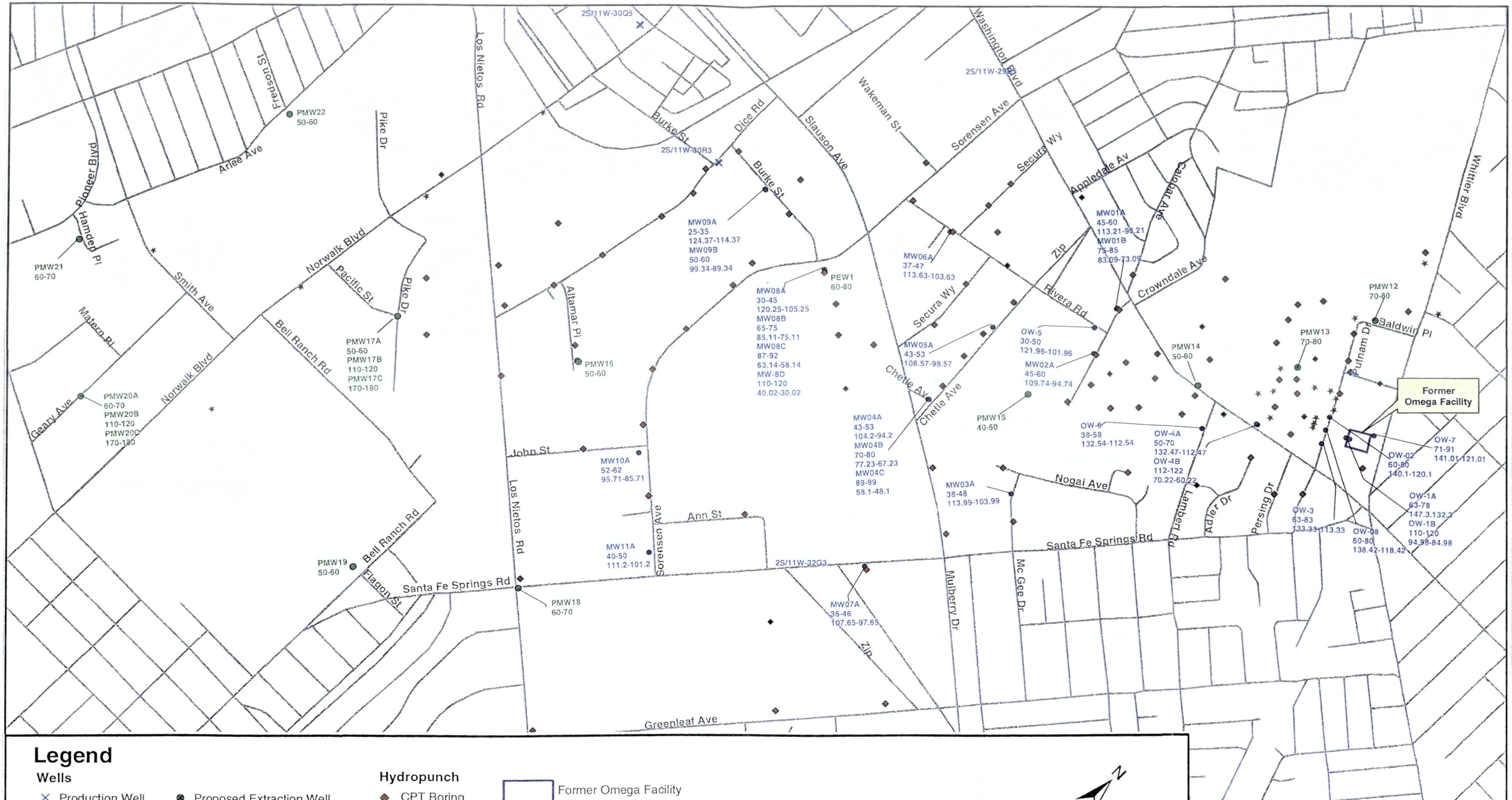

Legend

Wells

- × Production Well
- ● Monitoring Well
- ⊗ Proposed Extraction Well
- ● Proposed Monitoring Well

MW10A = Station Name
52-62 = Screen Depth
95.71-85.71 = Screen Elevation

Hydropunch

- ◆ CPT Boring
- ★ Auger Boring

□ Former Omega Facility

SOURCE: CH2M HILL, INC. FIGURE 3-1 PROPOSED WELL LOCATIONS

Area Manager K. THOMAS	ARCADIS	PROPOSED WELL LOCATIONS	Project Number CA646.01.01
Project Director J. FRIEDMAN	Arcadis of Los Angeles 1400 N. Harbor Boulevard, Suite 700 Fullerton, CA 92835-4127 Tel: 714-278-0992 Fax: 714-278-0051 www.arcadis-us.com	OMEGA CHEMICAL SUPERFUND SITE WHITTIER, CALIFORNIA	Drawing Date 9/7/04
Task Manager R. HALPERN			Figure 3-1
Technical Review R. HALPERN			

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Appendix A

Copy of CH2M Hill's DQOs

Data Quality Objectives (DQOs) Well Construction, Aquifer Testing, and Groundwater Sampling Remedial Investigation/Feasibility Study Omega Chemical Superfund Site Operable Unit 2

Step 1. State the Problem

(1) *Identify members of the planning team* - The members of the planning team are the Environmental Protection Agency (EPA) Work Assignment Manager (WAM), CH2M HILL Site Manager (SM), CH2M HILL Staff Hydrogeologists, and CH2M HILL Quality Assurance Officer (QAO).

(2) *Identify the primary decision-maker* - There will not be a primary decision-maker. Decisions will be made by consensus.

(3) *Develop a concise description of the problem* - The Omega Chemical Corporation (Omega) is a former refrigerant/solvent recycling operation located in Whittier, California, a community of approximately 85,000 people. Existing groundwater and soil data indicate that elevated concentrations of volatile organic compounds (VOCs) and other compounds are present the soil and groundwater beneath the former Omega Chemical Facility (Operable Unit 1 [OU-1]) and up to 2 miles downgradient in shallow groundwater. A series of soil gas, soil, and groundwater investigations have been performed at OU-1 by a variety of consultants beginning in 1985. Chlorinated hydrocarbons (primarily PCE, TCE, 1,1-DCE, cis-1,2-DCE, and chloroform) and Freons (Freon 11 and Freon 113) were identified as the primary chemicals of concern directly beneath the site. Elevated total chromium also was reported in groundwater beneath the Omega site. Perchlorate contamination is suspected. Other contaminants of concern (detected or suspected at the site) include cyanides, NDMA, pesticides and PCBs, dissolved metals, and 1,4-dioxane. Elevated concentrations of chemicals of concern were also reported west and southwest of the Omega facility, suggesting that a downgradient migration of the contaminant plume from the site has occurred.

Operable Unit 2 (OU-2) generally includes the groundwater-contaminated areas encompassing the Omega Chemical Facility and extends approximately 2.2 miles to the southwest. The vadose zone contamination at the Omega site and the highly contaminated portion of the aquifer in the immediate site vicinity are addressed as OU-1 under a separate effort. The primary objective of this investigation is to conduct an RI/FS to estimate the vertical and lateral extent of groundwater contamination within OU-2.

EPA has conducted a record search that indicated industrial facilities other than Omega Chemical likely contributed to groundwater contamination within OU-2. The current understanding is that the groundwater contamination present at OU-2 is a continuous, co-mingled plume originating from multiple source areas. This investigation will assess the continuity of groundwater contamination at OU-2 and characterize the main source areas of the contamination. Many of these facilities are currently under a regulatory oversight and the extent of contamination has been addressed by remedial investigation. As part of the Omega investigation, reports on these sites maintained at the Los Angeles Regional Water Quality Control Board (LA RWQCB) and Department of Toxic Substances Control (DTSC) will be reviewed and the information compiled and evaluated.

It is possible that characterization of some of the potential sources has not been completed and will need to be addressed under this investigation. Because the extent of such effort is unknown at this time, it is not included in this QAPP and will be addressed by an addendum to this document after additional information becomes available. It is anticipated that such future investigation, if necessary, will include soil gas and soil sampling, well installation, and aquifer testing.

The problem is summarized as follows:

(a) The vertical and lateral extent, as well as the nature of contamination in groundwater beneath OU-2 needs to be determined. The trend in contaminant concentrations in groundwater needs to be evaluated.

(b) The risk to human health and the environment from contaminants present at OU-2 needs to be assessed.

(c) The presence, extent, and concentrations of emergent contaminants (1,4-dioxane, perchlorate, NDMA, hexavalent chromium, and 1,2,3-trichloropropane [1,2,3-TCP]) in groundwater surrounding and downgradient of the Omega site need to be determined.

(d) The remedial action best suited to site conditions needs to be selected to restore the aquifer, prevent the contamination of nearby drinking water wells, prevent ongoing contamination migration, and prevent exposure to humans and the environment.

(e) Investigation-derived waste (IDW) generated during field activities (e.g., drill cuttings, well development water, well purge water, and aquifer testing water) will need to be properly disposed in accordance with state, federal, and local regulations.

(4) *Specify available resources and relevant deadlines for the study –*

Although not complete, investigations have been performed previously at the Omega site. The site history, past investigations, and remediation activities are discussed in detail in the *Final On-Site Soils RI/FS Work Plan* (Camp Dresser & McKee [CDM], 2003) and the *Omega Chemical Superfund Site; Whittier, California; Phase 2 Groundwater Characterization Study Report* (Weston Solutions, Inc. [Weston], 2002).

Data obtained in 1988 from site assessment activities, including groundwater and soil sampling conducted by the site owner/operator, Dennis O'Meara, and data from a preliminary assessment conducted by EPA in January 1995, indicated the presence of hazardous substances in subsurface soil and groundwater at the site, including methylene chloride, PCE, and TCE. The presence of these substances and deteriorated underground storage tanks at Omega lead EPA to determine that an imminent and substantial endangerment requiring a removal action existed at Omega. On May 3, 1995, EPA issued an Action Memorandum authorizing a Removal Action involving the following response actions:

- Securing the site
- Sampling and categorizing hazardous materials
- Removing hazardous substances and grossly contaminated equipment, structures, and debris
- Sampling surface and subsurface soils and groundwater to determine the nature and extent of contamination
- Disposing, stabilizing, or treating grossly contaminated soils
- Grading, capping, and fencing contaminated soil areas

EPA has divided the Omega Chemical Superfund Site into two Operable Units: OU-1 and OU-2. OU-1 includes the Omega Chemical Facility property and extends a short distance west-southwest to Putnam Street (Weston, 2003). OU-2 surrounds the Omega Chemical Facility and extends offsite approximately 2.2 miles to the southwest. This DQO describes work to be completed within OU-2.

As part of the OU-1 effort, EPA entered into a Partial Consent Decree with the potentially responsible parties (PRPs) who had agreed to complete work at the site. This group is known as Omega Chemical Site PRP Organized Group (OPOG). This Partial Consent Decree was entered into the District Court on February 23, 2001. OPOG agreed to perform an RI/FS, conduct a Non-Time Critical Removal Action, perform a risk assessment, and install groundwater monitoring wells at OU-1, also referred to as the Phase 1A area.

As part of the OU-2 effort, EPA issued an order to another group of PRPs to complete work at OU-2 and initiated settlement negotiations with the remaining PRPs. The resolutions of these actions are pending. In the meantime, EPA authorized its consultant, CH2M HILL, to initiate the RI/FS at OU-2.

Record search conducted by EPA revealed on-going remedial activities at multiple facilities within OU-2. Relevant reports and other documents are available at LA RWQCB and DTSC.

A local water supply well is impacted and continues to be threatened, although it is not known at this time whether the contamination originated at Omega. If no action is taken, drinking water aquifers may become impaired by contamination from Omega and potentially also from other sources within OU-2. The OU-2 RI/FS is scheduled to be competed in 2006. For cost-estimating purposes in support of settlement negotiations, the duration of remedial action (RA) was assumed to be between 2006 and 2038 (remedial system construction between 2006 and 2008, and operation between 2009 and 2038). The time required to achieve aquifer restoration at OU-2 is necessarily longer; but the sense of urgency is nevertheless underscored by the need for taking action.

Step 2. Identify the Decision

(1) *Identify the principal study question* –

The apparent problem at the site is the migration to groundwater of chlorinated solvents and associated attenuation products, and potentially of other compounds. The current decision requires adequate data for use in plume delineation, contamination forensic evaluation, assessment of human health and ecological risk, and recommending a remedial action. The concentrations of these VOC and attenuation compounds are greater than background levels for the area and exceed health-based benchmarks in the vicinity of the site. The principal goals for CH2M HILL are to develop a sufficient amount of data to support selection of an appropriate approach for the site remediation and develop a well-supported Record of Decision (ROD). Achieving these goals includes answering the following study questions:

(a) What is the vertical and lateral extent and nature of contamination in groundwater beneath OU-2, and what is the trend in groundwater concentrations?

(b) Do contaminants pose an unacceptable potential risk to human health and the environment?

(c) Are emergent contaminants (1,4-dioxane, perchlorate, NDMA, hexavalent chromium, and 1,2,3-TCP) present in groundwater surrounding and downgradient of the Omega site?

(d) What remedial action will best suit the site conditions to restore the aquifer, prevent the contamination of nearby drinking water wells, prevent ongoing contamination migration, and prevent exposure to humans and the environment?

(e) How can IDW (e.g., drill cuttings, well development water, well purge water, and aquifer testing water) be properly disposed in accordance with state, federal, and local regulations?

(2) *Define alternate actions that could result from resolution of the principal study question* – The alternate actions for goals defined in (1) above will be, respectively:

(a) (1) The nature and extent of groundwater contamination will be based on existing information, including groundwater samples from past cone penetrometer test (CPT) investigations and a limited number of existing monitoring wells. Uncertainties regarding the extent of the plume will remain and changes in concentrations within areas previously characterized by in-situ samples will not be assessed.

(2) Additional well clusters will be installed and monitored at locations within the plume with no permanent monitoring wells at downgradient and lateral edges of the plume to characterize the lateral and vertical extent of contamination. These wells will be available for future monitoring to evaluate changes in contaminant concentrations in groundwater.

(b) (1) Additional data collection indicates that there is a risk to human health, (2) no risk, or (3) insufficient data.

(c) (1) If emergent chemicals are not present in groundwater, then commonly used technologies for groundwater treatment will be utilized. (2) If emergent chemicals are present, then additional groundwater treatment will be required.

(d) Remedial actions that may be considered include no action, natural attenuation, groundwater extraction and treatment system. The site conditions and treatment requirements may require collection of additional data or information to select a remedial action that will best suit the site conditions.

(e) Drill cuttings may be disposed as (1) nonhazardous soil in a Class II landfill, or (2) hazardous waste in a Class I landfill. IDW water can be disposed as clean water to a storm drain if no contaminants exceeding maximum contaminant levels (MCLs) or Action Levels (ALs) are present. Wastewater containing contaminants above ALs or MCLs must be treated onsite or disposed at a treatment, storage, and disposal facility (TSDF).

(3) *Combine the principal study question and the alternative actions into a decision statement* –

(a) If the new understanding of the nature and extent of groundwater contamination is shown to be significantly different than the current understanding, then a different remedial approach may need to be considered. If the new data are not sufficient to adequately characterize the nature and extent of the contamination, then additional wells will be installed and/or the duration of monitoring extended.

(b) If the contaminants at OU-2 pose an unacceptable potential risk to human health and the environment, a remedial action will be recommended. No action will be recommended otherwise. A recommendation for collection of additional data will be made if the risk cannot be fully assessed based on the data collected.

(c) If emergent contaminants are present, additional treatment technologies for groundwater may be required.

(d) If the selection of a remedial action that will best suit the site conditions cannot be made based on the data available, additional data or information will be collected.

(e) IDW water will be treated onsite and discharged as clean if onsite treatment is feasible. If IDW water cannot be treated onsite, it will be disposed at a TSDF. If drill cuttings have not met nonhazardous waste criteria, they will need to be placed in a Class I landfill. If drill cuttings have met nonhazardous waste criteria, they will be placed in a Class II landfill.

(4) *Organize multiple decisions* - Based on the answers to the principal study questions, decisions about alternate actions and additional phases of RI/FS activities will be made during the progress of the RI/FS. The resolution of 3(b) and 3(c) may impact 3(a) by requiring that additional data or information be collected.

(a) The updated assessment of the nature and extent of contamination may indicate that the VOC plume has migrated further downgradient or to a greater depth than is currently expected. If so, it may result in the need for additional monitoring wells and extended groundwater monitoring.

(b) If a risk of exposure is determined to exceed human health or ecological criteria, then a remedial action to reduce that risk to an acceptable level will be recommended.

(c) The presence of emerging contaminants in groundwater may necessitate additional site characterization and groundwater treatment technology.

(d) If IDW water can be treated onsite, it will be discharged as clean. If IDW water cannot be treated onsite, it will be disposed at a TSDF. If drill cuttings have not met nonhazardous waste criteria, they will need to be placed in a Class I landfill. If drill cuttings have met nonhazardous waste criteria, they will be placed in a Class II landfill. The range of IDW disposal options was presented and the associated waste profiling specified; evaluation of other disposal options is not required.

Step 3. Identify Inputs to the Decision

The purpose of this step is to identify the information and measurements needed to support the decision statement. The data will be evaluated with regard to the four principal questions of the RI/FS.

(1) *Identify the information that will be required to resolve the decision statement* – Based on data uses and availability, the following data are needed:

(a) To resolve the decision statement, the planning team will need contaminant concentration data for groundwater samples from new and existing monitoring wells, and hydrogeological data (including historical) from existing wells, as well as applicable regulatory criteria for the following constituents: VOCs, semivolatile organic compounds (SVOCs), metals, perchlorate, and hexavalent chromium.

(b) To resolve the decision statement (b), the planning team will need groundwater and soil concentrations of contaminants listed under (a) and (c), appropriate human health risk and ecological risk criteria, information on exposure pathways, and exposure information.

(c) To resolve the decision statement (c), the planning team will need the analytical results for emerging contaminants (1,4-dioxane; perchlorate; NDMA; 1,2,3-TCP; hexavalent chromium) from site monitoring wells as well as applicable regulatory criteria.

(d) To resolve the decision statement (d), aquifer hydraulic characteristics derived from aquifer testing will be used to provide information critical to assess contaminant fate and transport and evaluate remediation alternatives. Groundwater elevations and contaminant concentrations in groundwater will be measured to define groundwater flow direction, allow plume tracking over time, and provide calibration data for the numerical model to assess contaminant fate and transport and evaluate remedial alternatives. Analytical results for groundwater samples, including compounds listed under (a) and (c), and additional compounds (nitrate, sulfate, methane, total dissolved solids [TDS], biological oxygen demand [BOD], chemical oxygen demand [COD], pH) will be used to select the treatment technology. Hydraulic conductivity, soil moisture, redox potential, cation exchange capacity, and total organic carbon (TOC) will be used to evaluate contaminant fate and transport.

(e) To resolve the decision statement (e), the planning team will need the analytical results for the IDW, both soil cuttings and groundwater, as well as applicable regulatory action levels and screening criteria.

(2) *Determine the sources for each item of information identified:* The results from this investigation will provide the necessary information to resolve the decision statement. Data from previous site investigations will be utilized as needed.

(a) Lithologic and laboratory analytical data from samples collected at new and existing monitoring wells.

(b) Soil and groundwater analytical data collected during this and previous investigations as well as information on exposure pathways.

(c) Laboratory analyses of emerging compounds from groundwater samples collected from the new and existing wells.

(d) Data collected under (a), (b), and (c), aquifer test results, regulatory requirements, cost analysis.

(e) Laboratory analysis results for samples of IDW water and soil.

(3) *Identify the information that is needed to establish the action level* – Action levels will be generated in the risk assessment using EPA guidance.

(a) The regulatory action levels include California and federal drinking water standards, ALs in California, and California Public Health Goals (PHGs) (Table A-1 in the main text of this QAPP). Method detection limits and historical concentrations, as appropriate, will be used for unregulated drinking water compounds.

(b) A risk assessor will evaluate human health and ecological risk; specific action levels will not be recommended.

(c) California ALs will be applied.

(d) If groundwater treatment is required, discharge options will be guided by MCLs, California ALs, California PHGs, Los Angeles Basin Plan Water Quality Objectives, National Pollutant Discharge Elimination System (NPDES) Permits, California Toxic Rules, and South Coast Air Quality Monitoring District Permits.

(e) For IDW soil: 40 Code of Federal Regulations (CFR) Section 261.24, 22 California Code of Regulations (CCR) Section 66261.24, and waste acceptance criteria for offsite nonhazardous waste TSDF. For IDW water: California Toxic Rules (40 CFR Section 131.38), 22 CCR Section 64431 (Drinking Water Standards); Department of Health Services (DHS); Office of Environmental Health Hazard Assessment (OEHHA); and best professional judgment.

(4) *Confirm that appropriate measurement methods exist to provide the necessary data* – The appropriate methods have been identified to meet project needs and are shown in the QAPP.

Step 4. Define the Boundaries for the Study

(1) *Specify the characteristics that define the population of interest* –

(a) Concentrations of chlorinated solvents and their degradation products, and other parameters, including VOCs, SVOCs, pesticides/PCBs, cyanide, perchlorate, and metals in groundwater within shallow unconsolidated sediments.

(b) Same as (a). The groundwater samples will be collected following a systematic rather than statistical sampling design.

(c) Concentrations of emerging contaminants in groundwater within shallow unconsolidated sediments.

(d) Impacted groundwater within shallow unconsolidated sediments.

(e) IDW soil and water containerized in roll-off bins, tanks, 55-gallon drums, and other storage containers.

(2) *Define the spatial boundary of the decision statement* –

(a) Define the geographical area to which the decision statement applies – The boundary of OU-2 is the extent of the contamination in groundwater. One objective of the RI/FS (principal study question a) is to determine the extent of the spatial boundary. This geographical area applies to all principal study questions.

(b) Divide the population into strata that have relatively homogeneous characteristics – For all the principal study questions, the contaminated aquifer may be considered one stratum.

(3) *Define the temporal boundary of the decision statement* –

(a) Determine the timeframe to which the decision statement applies – For principal study questions (a), (b), and (c), the timeframe is 2 years, the duration of the project. For principal study questions (d) and (e), the duration if indefinite because the liability associated with the remedy and IDW disposal extends into the future.

(b) Determine when to collect data - The anticipated duration of the RI/FS is 2 years (all principal study questions).

(4) *Define the scale of decisionmaking* – The scale of decisionmaking will be limited to the OU-2 area (the same geographic boundary).

(5) *Identify practical constraints on data collection* – The sampling locations and schedule may depend on site access, permitting, and right-of-way constraints. For all principal study questions, there are practical funding limitations imposed by Congressional appropriations. The decisions and professional practices will be based on the current scientific understanding of contaminant fate and transport, adverse effects of contaminants on human health and environment, and treatment of contaminated media.

Step 5. Develop a Decision Rule

(1) *Specify the statistical parameter that characterizes the population of interest*

(a) Sample analysis reports will be compared to action levels. Each value, not a statistical parameter such as mean concentration, will be evaluated against the action levels.

(b) Sample analysis reports will be compared to action levels on a point-by-point basis.

(c) Sample analysis reports will be compared to action levels. Each value, not a statistical parameter such as mean concentration, will be evaluated against the action levels.

(d) The full range of concentrations will be used semi-quantitatively in the evaluation of remedial alternatives.

(e) Sample analysis reports will be compared to applicable criteria on a point-by-point basis to characterize IDW soil for disposal and IDW water for treatment and discharge.

(2) *Specify the action level for the study –See Step 3, Item (3).*

(3) *Develop a decision rule (an "if…then…" statement) –*

(a) If an analytical result is greater than an action limit, then the sampling location can be included in OU-2 and may warrant further investigation.

(b) If the assessment of risk concludes the contamination at OU-2 poses an unacceptable risk to human health and/or the environment, a remedial action will be recommended.

(c) If emerging contaminants are detected, remedial alternative selection will include appropriate treatment technologies.

(d) If the collected data allow for clear identification of remedial alternatives, the alternative selection will be developed; otherwise, additional data or information will be collected.

(e) If waste soil profiling indicates the results meet nonhazardous waste criteria, the IDW soil will be shipped to a Class II landfill; otherwise, it will be transported to a Class I landfill. If waste profiling for IDW water indicates it meets regulatory requirements, it will be treated and discharged onsite; otherwise, it will be send to a TSDF.

Step 6. Specify Tolerable Limits on Decision Errors

Tolerable limits on decision errors, which are used to establish performance goals for the data collection design, are specified in this step.

(1) *Determine the range of the parameters of interest* – The available historical range of the parameters of interest (for principal study questions a, b, c, and d) is known for a portion of OU-2 only. Concentrations of chlorinated hydrocarbons in groundwater ranged from nondetect to tens of thousands of micrograms per liter (µg/L).

Concentrations of perchlorate were less than 7 µg/L. Part of principal study question (a) is to determine the range of contaminant concentrations. The historical range of contaminant concentrations in IDW (principal study question e) was not known at the time of preparation of this document.

(2) *Identify the decision errors and choose a null hypothesis* – For principal study questions a through d: The DQO guidance prescribes the identification of the null hypothesis and associated decision errors for determining the number of random samples and the locations to attain a given level of confidence with the spatial distribution. Because samples will be collected at systematically selected locations, statistical decision errors cannot be defined. However, project error tolerances are defined in terms of precision, accuracy, representativeness, comparability, and completeness (PARCC) parameters in Section A.4 of this QAPP. Analyte-specific accuracy and precision ranges are shown in Table A-2 of this QAPP. The project completeness goal is set at 90 percent. The laboratory data will be evaluated against PARCC requirements as outlined in the QAPP. Possible decision errors will be considered tolerable when data meet stated PARCC goals.

For principal study question e, for IDW soil, guidance published in EPA Publication SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, will be followed (see Step 7, Item 3). For IDW water, mixing is expected to occur while each Baker tank is being filled, thus providing a well-mixed, homogeneous condition for sample collection.

(3) *Specify a range of possible values of the parameter of interest where the consequences of decision error are relatively minor* – Not applicable.

(4) *Assign probability values to points above and below the action level that reflect the tolerable probability for the occurrence of decision errors* – Applies to all principal study questions: Because sample locations are predetermined, probability values cannot be assigned. Instead, error tolerances are defined in terms of the PARCC parameters and are explained in Section A.4 of the QAPP. Needed project accuracy and precision ranges are shown in Table A-2 of the QAPP for the individual analytes. The completeness goal for the project is set at 90 percent.

Step 7. Optimize the Design

(1) *Review the data quality objective (DQO) outputs and existing data*

(a) The results will also be compared to historical data and to regulatory action levels (e.g., state and federal MCLs, California ALs, PHGs) as per the objectives described above. Discrete groundwater sampling and screening-level laboratory analysis of the discrete samples will be used to select the screen depth intervals of the new monitoring wells.

(b) Existing (i.e., historical) data will also be included in the risk assessment. The analytical results for the discrete-depth groundwater samples and IDW samples will not be used in the risk assessment.

(c) The results will also be compared to historical data and to regulatory action levels (e.g., California ALs) as per the objectives described above.

(d) Areally averaged concentrations in groundwater will be used to estimate the average influent concentrations, which then can be used for the feasibility evaluation and treatment unit process design.

(e) The waste profiling results will not be compared to past IDW results. For proper disposal, the waste profiling results will be compared to applicable screening criteria, federal and California hazardous waste action levels, and facility-specific waste acceptance criteria.

(2) *Develop general data collection design alternatives* –

(a) None anticipated. Sampling will be done from fixed well locations which are based on professional judgment, so there are no alternatives.

(b) None anticipated. Samples will be collected at locations selected as part of principal study questions a and c.

(c) None anticipated. Sampling will be done from fixed well locations which are based on professional judgment, so there are no alternatives.

(d) None anticipated. The feasibility study will use areally averaged results from samples collected at fixed well locations which are based on professional judgment, so there are no alternatives.

(e) Representative sampling of IDW soil can be achieved either by averaging the results of separate samples collected, or by collecting the samples, compositing first, and then analyzing the composited sample. The IDW water is expected to be relatively well-mixed as holding containers are filled. Given that the constituents are expected to be in the dissolved phase (not in nonaqueous phase), a single sample per container should be representative of the wastewater.

(3) *For each data collection design alternative, select the optimal sample size that satisfies the objectives* - None anticipated for principal study questions a through d; the sample size is based on professional judgment.

For DQO e, for IDW soil, the optimal sample size (see table below) is based on the requirements listed in EPA Publication SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.*

Volume (CY)	Minimum No. of Subsamples/Aliquots	Comments
<10	2	1 sample from each half
10 to 20	3	1 sample from each third
20 to 100	4	1 sample from each quarter
>100	1 per 25 CY	1 sample from each 25-CY portion

Note that roll-off bins are each 10-cubic yard (CY) bins and more than one roll-off bin may be grouped together for composite sampling.

For IDW water, one sample per 20,000-gallon tank is expected to be adequate.

(4) *Select the most resource-effective data collection design that satisfies the DQOs* –

(a) The proposed groundwater monitoring well locations were selected to fill data gaps in areas where the extent of the groundwater contamination is not known. Discrete groundwater sampling will be used to select a representative well screen depth and minimize the number of wells necessary.

(b) All historical and new data will be used.

(c) Same as (a).

(d) Same as (b).

(e) Attempts will be made to separate relatively clean IDW from contaminated IDW. Compositing of samples from segregated IDW will minimize the number of laboratory analyses.

(5) *Document the operational details and theoretical assumptions of the selected design in sampling and analysis plan* – The data collection program, including sampling rationale, is presented in the FSP (EPA, 2004).

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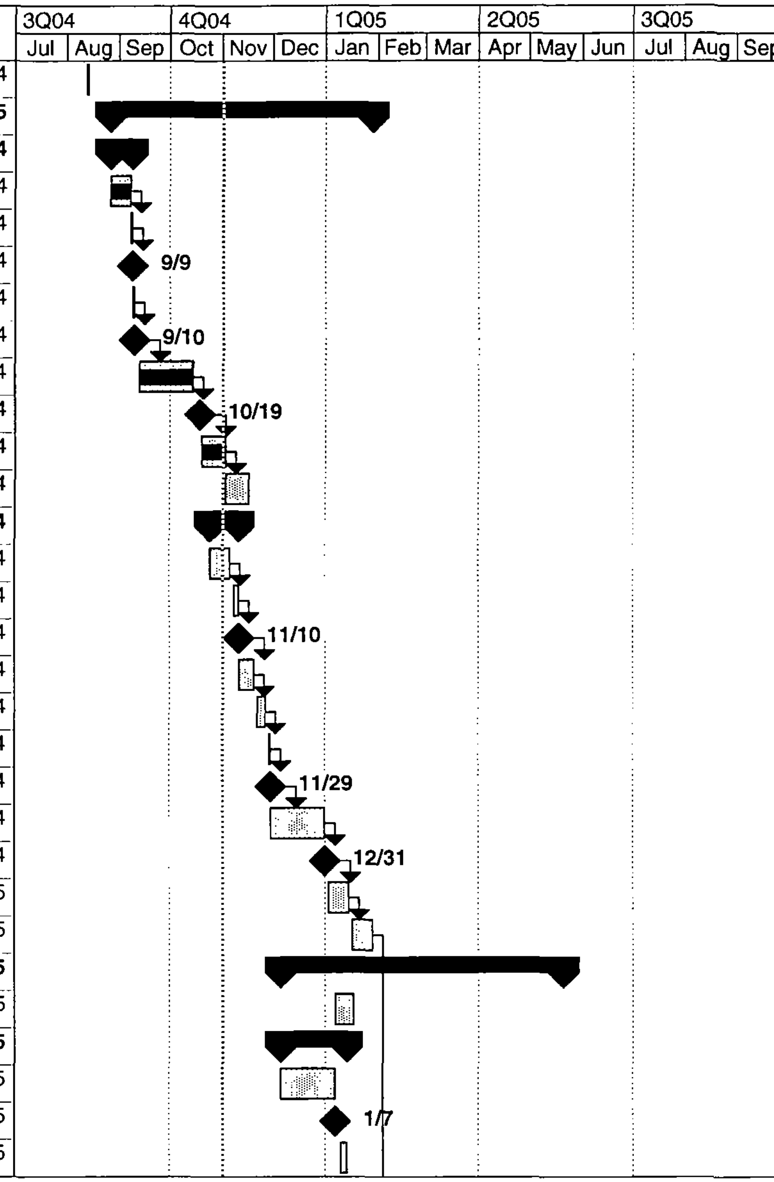
Appendix B

Project Schedule

PROJECT SCHEDULE - OMEGA CHEMICAL SUPERFUND SITE

ID	Task Name	Duration	Start	Finish
1	EPA Approval of Contractor	1 day	Fri 8/13/04	Fri 8/13/04
2	**Remedial Investigation Workplan Preparation**	**111 days**	**Fri 8/27/04**	**Fri 1/28/05**
3	**Draft Workplan Preparation**	**9 days**	**Fri 8/27/04**	**Thu 9/9/04**
4	Generate Workplan	8 days	Fri 8/27/04	Tue 9/7/04
5	Internal Review/Revision of Workplan	1 day	Wed 9/8/04	Wed 9/8/04
6	Submittal of Workplan	0 days	Thu 9/9/04	Thu 9/9/04
7	Production/Ship	1 day	Thu 9/9/04	Thu 9/9/04
8	Draft Workplan Due to EPA	0 days	Fri 9/10/04	Fri 9/10/04
9	EPA Review of Workplan	24 days	Mon 9/13/04	Thu 10/14/04
10	EPA Submits Comments to Workplan	0 days	Tue 10/19/04	Tue 10/19/04
11	Revise Workplan per EPA Comments	10 days	Wed 10/20/04	Tue 11/2/04
12	EPA Immediate Approval	10 days	Wed 11/3/04	Tue 11/16/04
13	**SAP, HASP and QAPP Preparation**	**13 days**	**Mon 10/25/04**	**Wed 11/10/04**
14	Generate SAP, HASP and QAPP	10 days	Mon 10/25/04	Fri 11/5/04
15	Internal Review/Revision	3 days	Mon 11/8/04	Wed 11/10/04
16	Submittal of SAP, HASP and QAPP	0 days	Wed 11/10/04	Wed 11/10/04
17	Client Review	7 days	Thu 11/11/04	Fri 11/19/04
18	Input Client Comments	5 days	Mon 11/22/04	Fri 11/26/04
19	Production/Ship	1 day	Mon 11/29/04	Mon 11/29/04
20	Draft SAP, HASP and QAPP Due to EPA	0 days	Mon 11/29/04	Mon 11/29/04
21	EPA Review of SAP, HASP and QAPP	24 days	Tue 11/30/04	Fri 12/31/04
22	EPA Submits Comments to SAP, HASP and QAPP	0 days	Fri 12/31/04	Fri 12/31/04
23	Revise SAP, HASP and QAPP per EPA Comments	10 days	Mon 1/3/05	Fri 1/14/05
24	EPA Immediate Approval	10 days	Mon 1/17/05	Fri 1/28/05
25	**Groundwater Monitoring Well Installation**	**121 days**	**Mon 12/6/04**	**Fri 5/20/05**
26	**Project Coordination**	7 days	Fri 1/7/05	Mon 1/17/05
27	**Prefield Activities**	**29 days**	**Mon 12/6/04**	**Thu 1/13/05**
28	Permitting	24 days	Mon 12/6/04	Thu 1/6/05
29	Site Recon/Mark Borings	0 days	Fri 1/7/05	Fri 1/7/05
30	Dig Alert & Geophysical	4 days	Mon 1/10/05	Thu 1/13/05

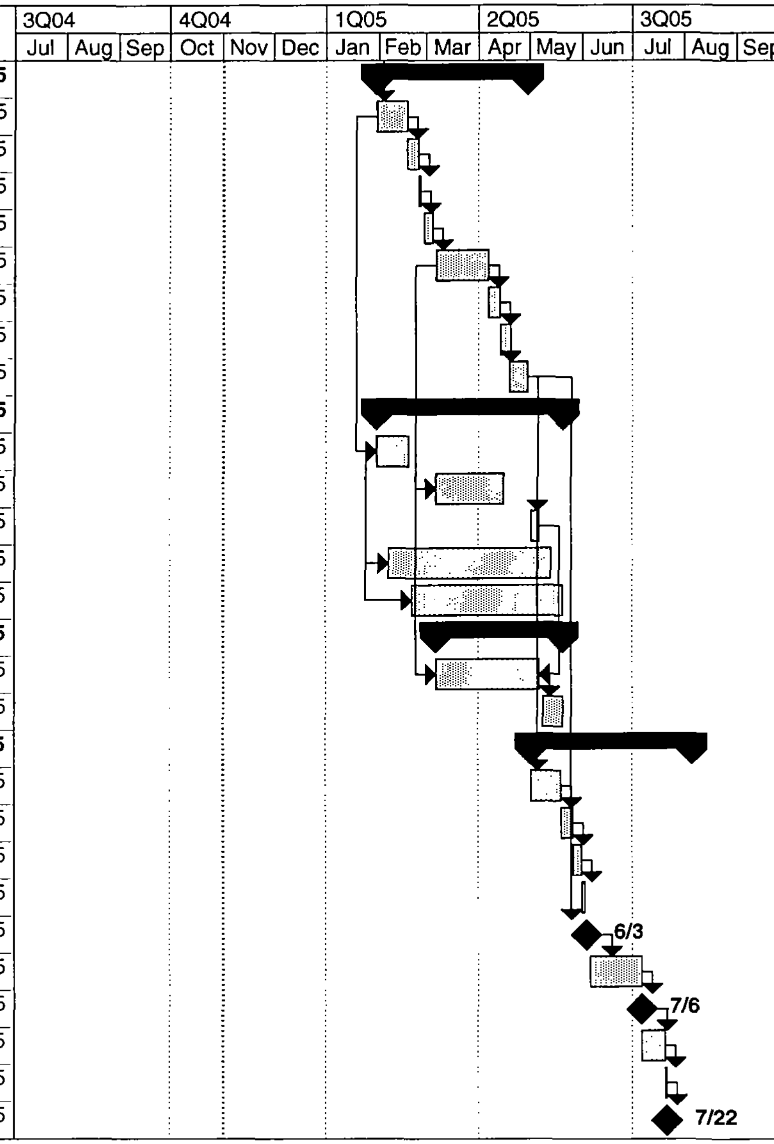


Project: Omega 081004 Sched
Date: Mon 11/1/04

Task		Milestone		External Tasks	
Split		Summary		External Milestone	
Progress		Project Summary		Deadline	

PROJECT SCHEDULE - OMEGA CHEMICAL SUPERFUND SITE

ID	Task Name	Duration	Start	Finish
31	**Field Activities**	**66 days**	**Mon 1/31/05**	**Fri 4/29/05**
32	CPT Screening of Proposed Well Locations	14 days	Mon 1/31/05	Thu 2/17/05
33	Review/Evaluate CPT Data	5 days	Fri 2/18/05	Thu 2/24/05
34	Confirm w/EPA Proposed Well Locations	1 day	Fri 2/25/05	Fri 2/25/05
35	Dig Alert & Geophysical for New Locations	5 days	Mon 2/28/05	Fri 3/4/05
36	Drill/Sample Soil/Install Wells	24 days	Mon 3/7/05	Wed 4/6/05
37	Develop Wells	5 days	Thu 4/7/05	Wed 4/13/05
38	Survey TOC & Well Locations	4 days	Thu 4/14/05	Tue 4/19/05
39	Gauge/Sample Wells	9 days	Tue 4/19/05	Fri 4/29/05
40	**Chemical and Physical Analysis**	**81 days**	**Mon 1/31/05**	**Fri 5/20/05**
41	Chemical Analysis - CPT Data	15 days	Mon 1/31/05	Fri 2/18/05
42	Chemical Analysis - Drilling Data	31 days	Mon 3/7/05	Fri 4/15/05
43	Chemical Analysis - Well Data	5 days	Mon 5/2/05	Fri 5/6/05
44	Internal Review of Data	71 days	Mon 2/7/05	Fri 5/13/05
45	External (Level III or IV) Data Review	66 days	Mon 2/21/05	Fri 5/20/05
46	**IDW Management**	**56 days**	**Mon 3/7/05**	**Fri 5/20/05**
47	IDW Profile	46 days	Mon 3/7/05	Fri 5/6/05
48	Waste Disposal	10 days	Mon 5/9/05	Fri 5/20/05
49	**Report Generation**	**70 days**	**Mon 5/2/05**	**Fri 8/5/05**
50	Draft Report Preparation	14 days	Mon 5/2/05	Thu 5/19/05
51	Internal Review/Revise of Draft	5 days	Fri 5/20/05	Thu 5/26/05
52	Client Review of Draft	3 days	Fri 5/27/05	Tue 5/31/05
53	Incorporate Comments and Finalize Draft	2 days	Wed 6/1/05	Thu 6/2/05
54	Submit Draft Report	0 days	Fri 6/3/05	Fri 6/3/05
55	EPA Review of Draft Report	23 days	Mon 6/6/05	Wed 7/6/05
56	EPA Comments Submitted	0 days	Wed 7/6/05	Wed 7/6/05
57	Revise Draft Report	10 days	Thu 7/7/05	Wed 7/20/05
58	Submit Final Report	1 day	Thu 7/21/05	Thu 7/21/05
59	EPA Approval of Final Report	11 days	Fri 7/22/05	Fri 8/5/05



Project: Omega 081004 Sched
Date: Mon 11/1/04

Task		Milestone		External Tasks	
Split		Summary		External Milestone	
Progress		Project Summary		Deadline	

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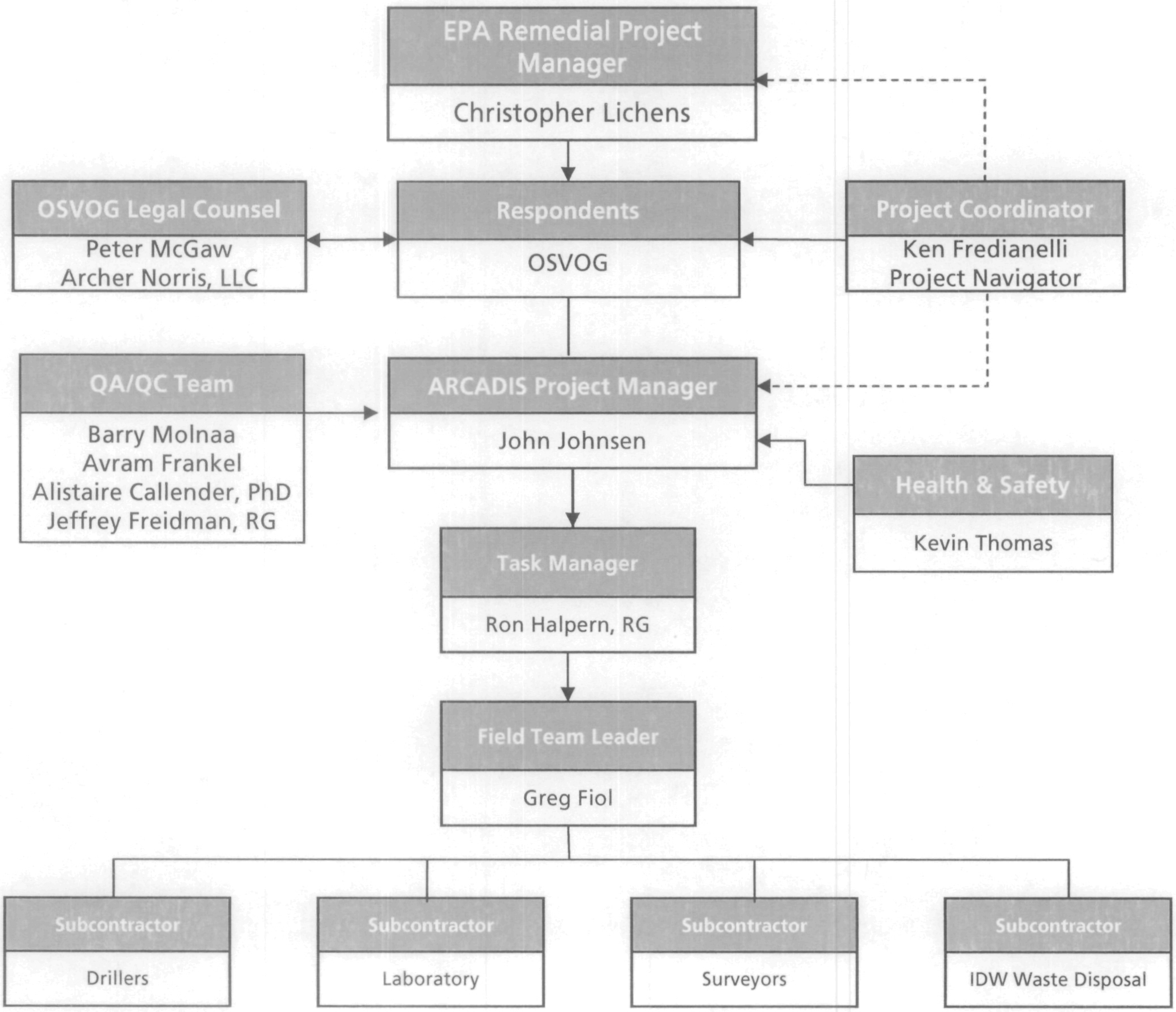
Appendix C

Project Organization Chart

ARCADIS G&M

Project Team

Remedial Investigation
Omega Chemical
OU-2



ARCADIS

Avram Frankel, PE

Principal Engineer

Education

MS, Environmental Engineering, Northwestern University, 1995

BA, History, Hopkins University, 1989

Professional Registrations

Registered Professional Engineer in California, Civil, (No. C59980)

Registered Environmental Assessor II in California (No. 20134)

Professional Associations

American Waste Water Association

National Ground Water Association

American Association for Environmental Health and Sciences

Groundwater Resources Association of California

Mr. Frankel's professional experience includes 15 years of multidisciplinary environmental project management, remediation engineering, and site assessment experience including extensive work as a PM and project engineer on CERCLA sites. Currently, Mr. Frankel leads the ARCADIS Northern California environmental practice. As a principal engineer, Mr. Frankel has considerable experience in the design and implementation of remediation systems, including soil vapor extraction, dual phase extraction, groundwater pump and treat, free-product recovery, bioventing, air sparging, in-situ chemical oxidation and in-situ bioremediation. Mr. Frankel has managed a wide-variety of environmental projects for a numerous public and private-sector clients including guaranteed fixed-price contracts. Mr. Frankel has considerable experience in the preparation of complex technical deliverables, from design documents to technical studies and specializes in the generation of risk-reducing strategic plans and remediation construction contracting strategies to reduce lifecycle costs for large environmental liabilities. Mr. Frankel also has extensive experience in the design of cost-saving instrumentation and control systems including SCADA and remote telemetry to reduce long-term remediation costs and optimize system performance. Specific project experience includes:

Former Ordnance Facility
Private Client, Hollister, CA
Serving as PM for a multimillion dollar cleanup of a former explosives manufacturing site. COCs include perchlorate, chlorinated solvents, and Cr^{+6}. Work scope includes development of a groundwater model to evaluate and select a final groundwater cleanup alternative to protect downgradient irrigation wells. ARCADIS has implemented in-situ bioremediation as an interim measure for source areas resulting in signifcant decreases in COC concentrations. Additional work includes the evaluation of soil remediation alternatives.

Lorentz Barrel and Drum NPL Site
US EPA, San Jose, CA
Designed an 800 SCFM dual-phase extraction system at this Superfund site under the EPA ARCS contract. Oversaw remedial field activities including the construction of a DPE system and asphalt concrete cap (2MM project cost). Completed significant field engineering changes to ensure construction was completed on time, despite difficult site conditions. Managed the shakedown and optimization of the DPE system. The design and construction of this successful remedial design earned Mr. Frankel a commendation from the U.S. EPA and allowing the client to complete the remedial action on time and on budget. Remote telemetry design resulted in considerable O&M cost savings.

Santa Rosa Local Study Area
U.S. EPA, Santa Rosa, CA
Managed a large assessment for U.S. EPA that included the first use of cone penetrometer technology (CPT) on an EPA CERCLA Removal Program site.

Mr. Frankel's use of CPT to collect lithologic, hydrogeologic, chemical, and remedial design data in a complex alluvial environment resulted in the location of numerous point sources at significant cost savings. Coordinated the project with federal, state, and local officials, and also oversaw the activities of a field laboratory, which yielded considerable additional cost savings to the client.

Singer-Friden State Superfund Site
Cal-EPA, San Leandro, CA
Served as project manager and design engineer for a 200 gpm groundwater remediation system with a total task order value over $1 MM constructed for DTSC. Completed the design package for the system and oversaw its construction. The system include PLC-driven control and SCADA. Efforts resulted in completion of key client milestone on-time and on-budget. Remote telemetry design resulted in considerable O&M cost savings.

Port Costa Terminal Remediation
ChevronTexaco/ConocoPhillips, Port Costa, CA
Served as the project manager and lead engineer for the remediation of this abandoned oil terminal. Managed a rapid system upgrade that brought the system into compliance with RWQCB and U.S. EPA requirements, while significantly reducing O&M costs. Responsibilities included regulatory liaison, site conceptual model (SCM) and exit strategy development; and O&M management. Efforts resulted in significant costs savings for the client while establishing a perfect compliance record for the project. In addition, SCM and business plan development established a 10-year exit strategy for the site.

Del Monte
Private Client, Monterey, CA
Serving as project manager for the remediation of a large plume impacted by chlorinated solvents from a former dry cleaner. Remediation is occurring via enhanced reductive dechlorination. The project is being completed under a guaranteed fixed price contract under the Central Coast RWQCB. ARCADIS is currently implementing a passive diffusion sampling bag program to reduce monitoring costs.

Fig Garden Village
Private Client, Fresno, CA
Serving as project manager for the remediation of a plume impacted by chlorinated solvents from a former dry cleaner. The project is being completed under a guaranteed fixed price contract under the Central Valley RWQCB and has included the implementation of SVE and MNA.

Baylands Recovery Project
SF Public Utilities Commission, Menlo Park, CA
Served as project manager and lead engineer for the completion of a RAP and remedial design for a lead-impacted salt pond and upland area. This high-profile project involved a detailed assessment of removal and treatment

technologies against cost, implementability, and effectiveness criteria and extensive coordination with regulatory agencies. The estimated remedial action cost was $10M. Despite the difficult regulatory environmental and implementability concerns given the soft site sediments, the RAP and remedial design were accepted by all stakeholders within the required project timeframe and resulted in a successful bid.

Castro Cove
ChevronTexaco, Richmond, CA
Lead engineer for remedial action plan, pre-design studies and innovative design/build contract documents for a salt marsh in SF Bay impacted with PAHs and mercury. Project involved solving complex technical and implementability issues to devise removal strategy for 120,000 cubic yards of sediments. The project resulted in formulation of a cost-saving design/build approach to meet the challenge of removing large quantities of sediments in a tidal environment.

Mountain Lake Remedial Design
Presidio Trust, San Francisco, CA
Prepared a preliminary remedial design and implementation plan for the restoration of this urban lake containing lead-impacted sediments under the Trusts's CERCLA program. These deliverables were prepared after extensive stakeholder meetings and presented a cost-effective stakeholder-accepted approach to a removal with complex implementability issues.

Port of Oakland TOFC
Port of Oakland, Oakland, CA
Served as project manager and lead engineer for this diesel free product recovery and groundwater treatment system associated with the Vision 2000 port expansion program. System design was completed quickly to meet the Port's compliance and engineering requirements. The system includes SCADA technology to reduce O&M costs. Mr. Frankel oversaw system construction, startup, and O&M. Efforts resulted in rapid completion of construction in midst of Port terminal expansion and achievement of associated regulatory compliance.

Port of Oakland GWE
Port of Oakland, Oakland, CA
Served as project manager and lead engineer for the design and construction of a groundwater recovery system at Berths 59 and 60 to protect San Francisco Bay. Project design provided San Francisco Bay protection required to keep high-stakes wharf construction on schedule.

ICI Paints Remediation Evaluation
Glidden Paints, San Francisco, CA
After overseeing the development of a variety of remedial approaches for the client, directed the design and bid for this large contaminated soil removal project under the City and County of San Francisco voluntary remediation program. Client benefits included avoidance of a cleanup and abatement order and receipt of cost-effective bids from contractors.

Dixon and Watsonville Bulk Plants Remedial Design
ConocoPhillips, Dixon and Watsonville, CA
Oversaw investigation, remedial design, and permitting activities for planned cleanups at these former Tosco bulk plants. Client benefits included cost effective remedial approach development and regulatory compliance.

Lee Pharmaceuticals Investigation
U.S. EPA, San Gabriel, CA
Designed and managed a detailed CPT investigation of subsurface chlorinated solvent contamination at an industrial facility. The investigation, completed well under budget, resulted in the identification of numerous previously unidentified VOC sources and key remedial design data.

Terra Vac Corporation Groundwater and Soil Remediation
Various Clients
Provided support to ongoing in situ groundwater and soil remediation projects. Responsibilities included: mass balance studies, construction oversight, system optimization studies, system design, permitting, and deliverables preparation. Remediation systems included vapor extraction, dual-phase extraction, bioventing, bioslurping, air sparging, and six-phase soil heating. In addition to completing system designs and optimization studies, Mr. Frankel served as a project engineer for the first commercial application of six-phase soil heating and vapor extraction at an industrial site in Chicago, Illinois.

Brown and Bryant NPL Site
U.S. EPA, Arvin, CA
As a key member of a field team, completed a long-term, Level-B subsurface assessment of an herbicide formulation facility to address contaminant migration to a public supply well. The assessment resulted in the location of soil fumigant point sources and field trial of a Dinoseb soil washing process under the EPA SITE program.

Suisun Bay Reserve Fleet Site Assessment
U.S. EPA, Suisun Bay, CA
Served as project manager on an assessment of abandoned drums and munitions on a WWII Victory-class freighter. The assessment involved rapid mobilization of a Level-B sampling effort and close coordination with the U.S. Coast Guard. Efforts resulted in data required by USCG while meeting stringent health and safety requirements.

Merced Dry Cleaners Investigation
U.S. EPA, Merced, CA
Completed a soil gas, soil, and groundwater investigation that documented a large release of chlorinated solvents from a local dry cleaning facility. Reduced costs by using direct push methods and field laboratory.

Greg Fiol

Project Manager

Mr. Fiol is a Project Manager with over 17 years of extensive experience in the environmental industry. Currently, Mr. Fiol serves as Project Manager on multiple projects ranging from facility investigations to active remediation for the chemical and petroleum industries. Mr. Fiol is responsible for defining the scope of work and ensuring that the tasks are implemented per scope, schedule, and budget. In addition, he serves as the Task Manager for construction related projects for the Los Angeles office. He has been responsible for overseeing construction projects ranging from small system installations to complex, large-scale construction and dirtwork projects. He has extensive experience reading design plans and specifications and has served as the construction manager for over 75 subsurface treatment system installations and several large excavation and earthwork projects. He has performed installation oversight and QA/QC inspection and testing of various types of pumps and motors and pressure testing of various types of piping. He has a sound understanding of all aspects of construction and system installation and often assists in specifying instrumentation to meet the needs of the client. Mr. Fiol has considerable experience in the environmental field, where he provides creative and innovative expertise on numerous projects. He confers with and advises project managers and engineers on construction requirements, contractor/subcontractor management, and remediation system design, installation, operation, and maintenance.

Mr. Fiol has been the Field Construction Manager for several facility decommissioning projects, large-scale excavation and grading projects and for projects requiring extensive and complex piping, both aboveground and subsurface. Mr. Fiol has overseen numerous monitoring well installations; geotechnical soil boring tests; vapor extraction pilot tests; aquifer pump tests; groundwater, vapor, and solid waste sampling; and UST/LUST management. In addition, he has developed field protocols relating to the operation and maintenance of remediation projects as well as groundwater sampling projects. Mr. Fiol coordinates the activities of all field technicians in ARCADIS Geraghty & Miller's Southern California offices. Such coordination includes scheduling personnel with appropriate experience and resource leveling for such tasks as construction oversight, system installation and operation, and environmental sampling and monitoring.

International Light Metals Facility
Martin Marietta, *Torrance, CA*

Served as Field Construction Manager for the demolition of a 67-acre site previously zoned as heavy industrial use that was being redeveloped for commercial use. Mr. Fiol was responsible for the decontamination of demolition of several buildings and structures, and the excavation of 40,000 tons of soil impacted with PCBs, metals, chlorinated VOCs (including vinyl chloride), and petroleum hydrocarbons. Mr. Fiol coordinated all excavation equipment, delineation of impacted

Education

High School Graduate

Professional Registrations

Construction Engineering and Management Certificate Program, UCLA

California Licensed Contractor, Class "A", 571846

Professional Associations

Groundwater Resources Association of California

Hazardous Waste Association of California areas, and all soil transportation contractors to ensure proper handling of the soil. His responsibilities also included scheduling field personnel, subcontractors, and regulatory inspections, and ensuring that proper health and safety and regulatory requirements were met on-site. Mr. Fiol assisted in the preparation of the budget for this project, provided regular updates to the project manager and client, and completed the task under the proposed budget.

Served as the Construction Manager for the installation of five vapor extraction systems on a site in Torrance, CA. Primary responsibilities included directing all subcontractors during the installation of the plumbing and electrical for each treatment system. Also, Mr. Fiol was responsible for ensuring that compliance (SCAQMD and DTSC) air monitoring and sampling were performed throughout the project.

SCIT

Security Capital Industrial Trust, *Buena Park, CA*

Serving as Field Construction Manager for a large engineering construction project in Buena Park, California. Primary responsibilities include interfacing with the construction contractors, project manager, engineers, and developers to ensure that field construction activities are performed within the allotted schedule and budget. Also, Mr. Fiol is responsible for obtaining all subcontractor quotes, coordinating delivery of materials to the site, coordinating and supervising subcontractors, ensuring that all permit requirements are met, adjusting construction activities in the field as necessary to better fit the overall construction schedule, tracking the construction schedule and budget, and alerting the project team to foreseen changes in the scope of work at the site.

Excavation

City of Concord, *CA*

Served as Construction Manager for a 25,000 cubic yard excavation project. Primary responsibilities included oversight of field personnel relating to BAAPCD regulatory monitoring and soil confirmation sampling. Mr. Fiol was also responsible for coordinating all excavation activities and all off-site disposal issues. Mr. Fiol was the primary client contact in the field and was responsible for adhering to the schedule and budget. Mr. Fiol assisted with the preparation of monthly progress reports to the regulatory agencies as well as to the client.

Confidential Client, *Huntington Beach, CA*

Served as Construction Manager on a large vapor extraction/groundwater treatment system, which included a 750-SCFM thermal oxidizer and a fixed film bio-reactor. Primary responsibilities included coordinating with and directing all subcontractors with their specific tasks and performing QA/QC inspections prior to accepting work as complete. In addition, Mr. Fiol was responsible for conferring with the design engineers throughout the installation phase of the project regarding any changes to the design that needed to be made.

Chevron
Confidential Client, Los Angeles

Served as Construction Manager on a 5,000 cubic yard excavation project. Primary responsibilities included coordination and direction of field personnel and scheduling of equipment treatment for the construction of a vapor extraction/bioremediation treatment cell, including provisions for nutrient injection and sample collection.

Remediation
Shell, *Venezuela*

Provided technical support on multiple international remediation projects including performing a groundwater aquifer pump test in South America and performing a vapor extraction test at a refinery in Edmonton, Canada.

March Air Force Base
Army Corps of Engineers, *Adelanto, CA*

Provided technical support for the installation of a groundwater treatment system for TCE at March Air Force Base, Adelanto, CA. Primary responsibilities included assisting with the design of the treatment system, coordinating delivery of all equipment, directing subcontractors, and performing system start-up and shakedown and baseline sampling assistance.

Chevron, *Southern California*

Served as Project Manager for large operation and maintenance program in Southern California. Primary responsibilities included ensuring that 45 sites remained in regulatory compliance, and developing and ensuring that technicians followed O&M protocols for operating remediation systems. Responsibilities also included overseeing all reporting to various agencies as well as managing the program financial budget.

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Ronald M. Halpern, R.G.

Project Geologist

Mr. Halpern is a Registered Geologist and Registered Environmental Assessor in the State of California. In addition, he holds a California Contractors License, Class A and C-57. Mr. Halpern has successfully completed soil, soil gas, and groundwater assessments for numerous private, commercial and local government projects in southern and central California. Recent projects include Preliminary Endangerment Assessments (PEAs) and Removal Action Work Plans for the Los Angeles and San Francisco Unified School Districts; oversight of brownfields cleanups of former oil fields in Inglewood and Torrance, as well as an assessment of chlorinated solvents adjacent to the Montrose-Del Amo Superfund site. Mr. Halpern has over 15 years experience in the environmental field and offers diverse technical and a=management capabilities.

Representative Project Experience

- Conducting numerous Transaction Screens, Phase I and Phase II investigations for real-estate transactions. Typical sites investigated include new school acquisitions, school additions, day cares, apartment complexes, shopping centers, hotels, office buildings, knitting mills, dry cleaners, gasoline stations, clothing manufacturers, box manufacturers, paper mills, and winery.

- Project Manager and Principle Scientist for the removal of underground storage tanks (USTs), the assessment of soil and groundwater contamination, evaluation of remedial alternatives, preparation of a Remedial Action Plan (RAP) and designing the system for the remediation of soil and groundwater beneath a gasoline station in the city of Brea. The project involved intensive groundwater modeling (conducted by Mr. Halpem), an aquifer test, a vapor extraction test, and extensive drilling and soil sampling.

- Conducted groundwater modeling for the assessment of various configurations for groundwater cleanup at a major oil company bulk storage facility in Signal Hill, California.

- Provided technical support for litigation related to two major oil company gasoline stations. Responsible for gathering and analyzing data, and providing technical opinions as the extent and volume of contamination.

- Primary technical advisor for the cleanup of soil and groundwater for a La Mirada industrial facility impacted by PCE. Responsible for preparing evaluation of previous RAP, reassessment and redesign of system, and for tracking O&M.

- Project Manager and lead scientist for the investigation and remediation of a gasoline station site in Laguna Hills impacted by dissolved-phase and non-aqueous

Education

B.Sc., Geology, Ben-Gurion University of the Negev, Beer Sheva, Israel

Professional Registrations

California Registered Geologist (R.G) No. *6645*

California Registered Environmental Assessor (REA 1) No. 6424

California State Contractors License *(C-57)* for Drilling and Well Installation

California State Contractors License (A) for General Engineering

Professional Associations/Certifications

NGWA - IBM PC Applications in Groundwater Pollution and Hydrology

NGWA - A Modular Three-Dimensional Finite-Difference Groundwater Flow Model (MODFLOW)

NGWA - Understanding Migration, Assessment, and Remediation of Non-Aqueous Phase Liquids

Applications of Groundwater Modeling (MODFLOW, AT123D, SESOIL) to Solving Environmental Problems.

ASTM Environmental Site Assessment for Commercial Real Estate

AHERA Asbestos Building Inspector Course, NATEC Int'l

U.S. EPA — Indoor Air Vapor Intrusion

40-Hour Basic Health & Safety Training

8-Hour Supervisory Hazardous Substances/Waste Health & Safety Training

8-Hour First Aid & CPR Training

phase product. Responsible for providing representations and technical expertise of the environmental conditions of the property to the owner's legal counsel and plaintiff in a multi-million dollar law suit. Using good scientific principles and approach, was able to convince plaintiff in Clients lack of contribution to adjacent property impact, and provided technical expertise in jury trial suit. No damages were attributed to Client, and site has been remediated to satisfaction of local oversight agency.

- Project Manager and lead scientist for investigation of gasoline station site in Compton, California. Based on innovative approach, was able to show Client and Regulatory agencies that NAPE product beneath site consisted of "first-run" gasoline, a product of gasoline refining, and not refined gasoline.

- Provided technical expertise and analysis in litigation case relating to contribution of gasoline product to gasoline site already under remediation. Responsible for evaluating historical data and maintenance records, as well as environmental conditions of adjoining sites, making representations to Client and Client's legal counsel. Was able to reduce original estimate (100%) of contribution to 50% based on findings and calculations.

- Project Manager and Prime Contractor for cleanup of former equipment rental yard impacted by gasoline. Responsible for evaluating RAP, making recommendations to augment groundwater cleanup, oversaw installation of shoring, dewatering, excavation, backfill and compaction of excavation. Site closure was obtained within 6 months after work.

- Project Manger and Prime Contractor for the assessment of septic leaching field of commercial property in Malibu. Responsible for installing groundwater monitoring wells using direct push methods, groundwater monitoring, and report preparation.

- Provided technical support for the assessment and remediation of a precious metals facility in Los Angeles, California. Responsible for designing sampling and remedial excavation program. Regulatory agency (DTSC) involvement was kept to a minimum.

- Project Manager, Lead Scientist, and Prime Contractor for the assessment of a PCE plume beneath a metal plating facility in Glendale, California, within the Pollak Well Field Operable Unit Area. Site was designated a PRP based on previous investigations by others. Responsible for devising an economical approach to evaluating PCE contamination in soil and groundwater beneath site. Based on results of the investigation, evaluation of historical discharge data, and evaluation of site histories of nearby facilities, was able to obtain a No Further Action for

Client from LARWQCB and EPA, removing them from PRP list.

- Project Manager, Lead Scientist, and Prime Contractor for the assessment of a PCE plume in soil beneath a furniture manufacturer in La Puente, California, within the San Gabriel Valley Operable Unit. Responsible for devising economical approach to site investigation of site, obtaining permits to off-site access, making representations to Client and regulatory agencies. Based on results of investigation, was able to show Client, Clients legal counsel, and regulatory agency that PCE plume detected beneath site originated at off-site location. Based on results of investigation and negotiations with regulatory agency, was able to obtain a No Further Action from USEPA.

- Secondary technical support to the USEPA legal and technical staff for the investigation of contamination of the City of Santa Monica's municipal drinking water supply by methyl-tertiary butyl-ether (MTBE). Responsible for evaluating investigation reports, draft and review enforcement documents.

- Project manager and technical support to Los Angeles Unified School District (LAUSD) for the additional assessment and cleanup of the Jefferson New Middle School site in Los Angeles, California. Responsible for scoping of work, providing cost estimates, reviewing legal documents related to environmental issues associated with the site, client and agency correspondence, and responding to requests for environmental and litigation support on behalf of LAUSD.

ARCADIS

John R. Johnsen

National Director of Aerospace, Industrial Accounts Program

Mr. Johnsen is an environmental scientist supervising staff involved in environmental site assessment, site investigation and remediation projects. Strong leadership ability and utilization of teams has resulted in positive project outcomes and repeat business. Extensive CERCLA and RCRCA background including strong regulatory compliance expertise.

Education

B.A., General Biology, May 1988, California State University, Northridge

Post-Baccalaureate studies in Environmental and Occupational Health

Professional Registrations

State of California Registered Environmental Health Specialist (REHS)

State of California Registered Environmental Assessor (REA 1)

Category of Experience

CERCLA EXPERIENCE

Glendale North & South Operable Units (Crystal Springs), *Glendale, California*

While working for Lockheed Martin's Corporate Environmental Safety & Health program, Mr. Johnsen served as the Technical Committee Chairperson for the Glendale Operable Unit Potentially Responsible Parties (PRP) Group and was also responsible for supervising all aspects of construction for the Glendale North & South Operable Unit 5000-gpm groundwater treatment plant. Responsibilities included contractor selection and management, supervision of support staff, review and approval of all project-related documents prior to submittal to EPA and other regulatory agencies (Cal EPA-DTSC, CRWQCB and DHS). Documents included, but were not limited to, health and safety plans, contingency plans, operations and maintenance manuals and staffing plans. Provided support for DHS permit preparation and negotiations of permit requirements, including the preparation of an Extremely Impaired Source Water Evaluation. Participated in Consent Decree negotiations with EPA Region 9. Directly interfaced with internal and outside legal council.

After leaving Lockheed Martin, Mr. Johnsen was retained by Lockheed Martin as a consultant to provide continued project support that resulted in securing a modification to the municipality's existing drinking water permit. The permit modifications allow the use of water produced as part of a Superfund remediation project as a source of drinking water. His services included negotiations with EPA Region 9, the Department of Health Services, the City of Glendale Water & Power Department as well as numerous (PRPs).

Lockheed Shipyard Sediment Operable Unit (OU), Lockheed Shipyard - Yard I OU

Managed Lockheed Martin sediment remediation project located on Harbor Island in Seattle, Washington. Lead team of outside contractors and internal support staff to ensure project and regulatory deliverables were completed per project schedules. Negotiated site clean-up standards for heavy metals and tributyl tin. Negotiated remedial alternatives directly with EPA and the State of Washington Department of Ecology. Reviewed and approved reports and project documents prior to submittal to EPA to meet the best interests of the company.

Lockheed Shipyard - Yard I OU Upland Area

Managed Lockheed Martin uplands Superfund project located on Harbor Island in Seattle, Washington. Involvement included strategizing remedial design that resulted in the site being deleted from the National Priorities List (NPL).

West Waterway Operable Unit

Represented Lockheed Martin's interests as a PRP involved with a Superfund site that consisted of sediments impacted with metals and tributyl tin in sediments lining the West Waterway shipping channel between Harbor Island and West Seattle.

Former Martin Marietta – The Dalles, Oregon Aluminum Production Facility

Served as Regulatory Compliance Manager and Project Manager for operations relating to preparation of a Revised Part B Permit Application, NPDES discharge issues and the O&M of on-site treatment of leachate produced from two landfills. Negotiations with EPA Region 10 resulted in acceptance and implementation of low-flow purging techniques during groundwater monitoring activities associated with the CERCLA landfill and eventual deletion from the National Priorities List. Acted as regulatory liaison between Lockheed Martin and the State of Oregon Department of Environmental Quality.

Yellow Water Road – CERCLA Site

Mr. Johnsen served as a Technical Committee Member for this CERCLA site located in Baldwin Florida. PCBs were the main constituents of concern. Timely removal of wastes and expedited closure of contaminants remaining at the site through the construction of a monolith resulted in EPA Region IV touting the site as a Superfund Success

OTHER PROJECT WORK

Los Angeles Unified School District, *Los Angeles, California*

Project Supervisor responsible for implementing work under a five-year Master Services Agreement with Los Angeles Unified School District to provide Site Assessment, Site Investigation and Remedial Action Services. Managed all aspects of the contract; including client relations, staff resource allocation, budgeting, scheduling and invoicing. Specific work includes numerous Phase I Environmental Site Assessments, multiple Preliminary Endangerment Assessments and associated Workplans, Pre- and Post-Demolition Lead Surveys, preparation of Removal Action Work Plans and implementation of Remedial Actions. This contract has provided over $1.5 million in work over a three-year period.

Hino Motors Manufacturing Inc.

Provide regulatory compliance support services, including air permitting support and waste management planning to a foreign automotive firm currently establishing manufacturing operations in Southern California. Support also included site assessment and site investigation services to assist in the determination of a satisfactory location for the facility, as well as providing regulatory support to ensure timely permitting of paint booths and drying ovens.

Los Angeles Metropolitan Transportation Authority

Oversee staff performing site assessment and site investigation activities for the Los Angeles Metropolitan Transportation Authority, including Phase I Environmental Site Assessments, lead and asbestos surveys and site investigation services. Projects include a fueling station and commercial and residential sites.

Former Martin Marietta – Goldendale Aluminum Production Facility

Served as Regulatory Compliance Manager and Project Manager for ongoing activities at the site, including periodic groundwater monitoring and landfill cap inspections. Assisted Lockheed Martin's legal team in assessing long-term liabilities associated with past site activities. Acted as the regulatory liaison with the State of Washington's Department of Ecology.

Jackson Drop Forge Subsurface Drum Removal Project, *Jackson Michigan*

Served as Lockheed Martin's Project Manager and Regulatory Compliance Specialist as a 50% PRP on the subsurface drum removal project that was located in a wetlands area along the Grand River in Jackson, Michigan. Project successfully completed to the satisfaction of state and local regulatory agencies.

Former RCA Site, Cherry Hill, New Jersey

Facility demolition

Leamington, Utah

Well Abandonment Project

Former Martin Marietta Site, *Utica, New York*

Remedial System Operations and Maintenance oversight and regulatory compliance.

Green River Landfill Site, Kentucky

Represented Lockheed Martin as a PRP on state run cleanup.

Furr Property – Charlotte, North Carolina

Oversight of groundwater monitoring and reporting.

Former Teledyne-Singer – *Palo Alto, California*

Operations and Maintenance oversight of groundwater pump-and-treat system.

Project Audit Support

Participated in corporate audits at various Lockheed Martin manufacturing facilities throughout the United States. Audited OSHA, EPA, DOT and state regulatory programs. Evaluated management systems for effectiveness. Sites included:

Vandenburg Air Force Base, California
Conducted weeklong audit of hazardous waste management activities performed by Lockheed Martin at the Facility
Lockheed Martin, Marietta, Georgia – Conducted audit of hazardous waste and wastewater management activities

Lockheed Martin (Former RCA site), East Windsor, New Jersey – Audited ongoing site activities to determine potential liabilities associated with site closure

Lockheed Martin, Valley Forge, Pennsylvania – Audited ongoing site activities to determine potential liabilities associated with site closure

Participated on Lockheed Martin Corporate Environment Safety & Health Regulatory Compliance Team and Lockheed Martin California Companies Legislative/Regulatory Review Team.

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Jeffrey Friedman, R.G., REA II

Senior Project Manager

Education

M.S. Environmental Management, University of San Francisco, 1992

B.S. Geological Sciences, California State University, Northridge, 1983

ASTM Risk-Based Corrective Action (RBCA) training course, 2000

Professional Registrations

Registered Geologist, California, Arizona, Idaho, Oregon, Washington

California Registered Environmental Assessor II

Mr. Friedman is a Registered Geologist in California, Arizona, Idaho, and Oregon as well as a California Registered Environmental Assessor II. He is currently responsible for technical oversight, project management, and business development in the Los Angeles office. Mr. Friedman has successfully completed soil and groundwater contaminant studies for federal and commercial clients at numerous hazardous and solid waste sites across the United States. Recent projects include a TSCA PCB assessment and clean-up in Honolulu, Hawaii, chlorinated solvent groundwater assessment and remedial option analysis in Salt Lake City, Utah, and pesticide and fuel hydrocarbon assessment and remedial action as part of a restoration project to reclaim the Everglades in South Florida. With over 20 years of experience in environmental consulting, Mr. Friedman offers diverse technical and management capabilities and a strong background in strategic evaluation of complex environmental problems and solutions.

With a background in the investigation and management of heavily contaminated facilities, Mr. Friedman is able to efficiently provide comprehensive, cost-effective solutions to address large, complex projects. In addition, many projects require Mr. Friedman's specialization in the investigation of both soil and groundwater, assessment of contaminant fate and transport, and risk-based assessment and evaluation of environmentally impacted sites for Brown Field-type development.

Confidential Client, Benicia, California

Directed high profile assessment of residential neighborhood where a former uncontrolled hazardous waste landfill was reportedly located. Due to intense media coverage of the investigation and the potential for litigation, the project was designed to complete the assessment within 30 working days. The project team consisted of four field teams who collected and described over 300 soil samples, which were submitted for analysis to a California certified laboratory for a wide range of organic and inorganic constituents of concern. In addition to identifying the location of residual waste located on privately owned parcels, several bedrock groundwater monitoring wells were installed and sampled to assess the potential impact on groundwater beneath the development. Participated in public meetings and developed RI documents for DTSC review and approval.

Bay Area Drum, Hunters Point, California

Provided oversight and managed long term large scale groundwater sampling program to evaluate chlorinated solvent plume. Provided technical oversight on the development of soil remedial action program for impacted soil situated beneath former drum reconditioning plant. Developed human heath risk assessment to support remedial action in conjunction with on-site remediation of chlorinated solvent and metals impact soil situated on an adjacent property. Participated in public meetings to address neighboring residence concern about potential remedial action activities. Conducted investigation to assess the likelihood for presence of elevated lead in surface soil on privately owned neighboring residential housing tracts. Assessed and developed RI documents for DTSC review and approval.

Long Beach Naval Facility

U.S. Navy, Long Beach, CA

Managed the development of a remedial investigation and feasibility study (RI/FS) work plan and sampling and analysis plan (SAP) for the Long Beach Naval Shipyard and Station. The plan was prepared to meet guidance requirements under both the Department of Defense Installation and Restoration Program (IRP) and U. S. EPA Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The documents provided plans to complete a focused field investigation on thirteen sites identified in the site inspection (SI) report that will provide groundwater and soil quality data used to support both human and ecological risk management decisions.

Confidential Client, Kaneohe, Oahu, Hawaii

Managed the investigation and remedial action on a PCB-impacted site under guidelines required by the Toxic Substances Control Act (TSCA). Provided regulatory liaison services, developed work plan documents, supervised investigation and remedial action activities, developed closure documentation, and successfully gain closure for the project site.

Handford, Richland, Washington

Managed the development of a limited field investigation (LFI) report on the 100-NR-2 operable unit source area. This included the coordination between a team of geoscientists and human and ecological risk assessors to develop a document that met Department of Energy (DOE) guidance requirements. The analysis centered on the potential effects of a tritium and gross alpha/beta groundwater contaminant plume in the area of the 100 reactor area.

Santa Fe Railroad, Flagstaff, Arizona

Implemented soil and ground water assessment due to railroad car derailment per EPA cleanup order. Coordinated soil boring program with on-site GC field laboratory to evaluate the horizontal and vertical extent of chemical spill. Installed hard rock monitoring wells to assess the potential effects on near surface groundwater. Evaluated both analytical laboratory and field laboratory data. Prepared report to EPA Region 9 with recommendations for remedial action. Provided oversight during remedial action pilot study which included on-site bio-remediation.

Ashland Chemical, Santa Fe Springs, California

Installed ground water monitoring well for discrete sampling to evaluate horizontal and vertical extent of chlorinated hydrocarbon plume. Designed and constructed extraction well, and conducted aquifer test to evaluate potential communication between to saturated zones. Evaluated all analytical data and prepared report to Los Angeles Regional Water Quality Control Board. Conducted pilot study to evaluated UV Ozone treatment technology to address chlorinated solvent plume in upper aquifer. The study included the removal and treatment of nearly 100,000 gallons of PCE-impacted groundwater.

Chevron Marine Terminal, San Pedro, California

Installed and designed monitoring network to evaluate tidal influences on petroleum plume beneath the terminal. Implemented long term data collection focusing on the movement of the petroleum plume beneath the terminal. Evaluated hydrogeologic data and prepared report. Developed strategy for remedial action to remove petroleum plume and control releases into the neighboring San Pedro Bay.

Thomas Ranch Site (Resolution Trust Corporation), Corona, California

Provided technical guidance to the RTC Environmental Staff to evaluate existing data and make recommendations on how to finalize existing RI/FS documents. Services included: EPA Level 3 data evaluation of analytical data; development of a GIS database; evaluation of existing RI/BHRA/FS documents; and regulatory agency negotiations.

Designed and implemented due-diligence investigation which recommended a field sampling program to ascertain potential liabilities for the buyer. The field investigation was designed to access the potential for the site owner to be identified as a potential responsible party (PRP) due to properties proximity to an on-going State managed groundwater plume investigation. Services also included negotiation with the local enforcement agencies to determine clean-up levels and remedial action alternatives, as well as oversight of owner implemented remediation activities.

Service Chemical Company, Santa Ana, California

Provided project management and technical oversight to comply with RCRA closure requirements for a former solvent recycling site. Developed RFI document and negotiated with DTSC staff regarding future closure activities to be completed in compliance with an active Part B Permit. Current issues include the potential impact of municipal water wells located in the down-gradient flow direction and the development of a CMS detailing the potential methods of remediation.

Retail Center (Confidential REIT), Tustin California

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Alistaire B. Callender, PhD

Environmental Business Practice Manager – Los Angeles

Dr. Callender, Los Angeles Environmental Business Practice Manager, has worked for over 25 years in the fields of hazardous waste management, environmental chemistry, water treatment, wastewater treatment, industrial waste treatment, waste minimization and contaminated site investigation and remediation. He has broad experience in regulatory issues, project management, and working with regulatory agencies. He has been project manager on several projects involving investigation and remediation of sites impacted by petroleum hydrocarbons. He has provided support to the legal profession as an expert witness, and teaches at the University of California-Irvine in their Extension program.

He currently focuses on redevelopment activities working with public and private entities to convert environmentally impaired properties to commercial or residential use.

Representative Project Experience

- Principal-in-Charge for a 5-year on-call environmental services contract with the Los Angeles Unified School District (LAUSD), Dr. Callender provided project oversight of the Site Investigation and Remediation Team. He supported LAUSD's efforts to find new school sites and to expand existing school sites. He managed the team to perform Phase I Environmental Site Assessments, Preliminary Endangerment Assessments including ecological and human health risk assessments, and Remedial Action Plan development and implementation. He also provided regulatory compliance with DTSC and DOE guidelines, and is familiar with the regulations that are specific for school projects.

- Program Manager for on-call contract with the Metropolitan Water District of Southern California, under which Phase I, Phase II and Regulatory Compliance services were provided

- Client Manager and Technical lead for Phase I and Phase II Site Assessment services under a Master Service Agreement with Comerica Bank

- Project Manager of a multi-year, multi-million dollar contract with the Los Angeles County Metropolitan Transportation Authority (MTA), under which a wide variety of environmental engineering services were provided for the Metro Red Line Subway project. Dr. Callender managed a team of over 20 contractors, coordinated the activities of the project team with the client (The MTA), and negotiated with several regulatory agencies and other affected parties. Dr. Callender's role also included participating in public meetings to present project activities to interested parties. Other activities included preparation of NEPA/CEQA documents, Phase I and Phase II site assessments, development of remedial options,

Education

Certificate , The Executive Program In Management, University of California, Los Angeles, 1996

Ph.D. Environmental Science, University of Oklahoma, 1983

M.S., Environmental Science, University of Oklahoma, 1979

Diploma Water and Wastewater Technology, Water and Wastewater Technical School, Missouri, 1977

B.Sc., Chemistry, University of West Indies, 1969

Professional Registrations

OSHA 40-Hour Health & Safety Training Course

Registered Environmental Assessor (REA): California, 1988, No. REA-00159

Professional Associations

American Chemical Society

ASTM

Air and Waste Management Association

and implementation of the use of ArcView as a way of accessing and viewing environmental data.

- Development and implementation of underground storage tank management program for Douglas Aircraft Company (now a part of Boeing), including: tank and pipeline leak testing, installation of leak detection equipment, and investigation of soil and groundwater contamination resulting from tank leaks. Implemented a free product recovery program to reclaim jet fuel released as a result of leaks in a refueling line. Also performed due diligence evaluation prior to Douglas' acquisition of property at the Long Beach Airport.

- Project Manager for characterization of site impacted by diesel and gasoline releases from an adjacent gas station, and development of a Remediation Program to remove free product and treat impacted soil. Provided expert witness support in litigation brought by property owner against gas station owners.

- Dr. Callender was project manager for a study evaluating and remediating a concrete pipe manufacturing facility. The facility was converted to a business park, and the project involved identifying the environmental issues, and solving them so that the site could be redeveloped. Activities included obtaining closure of underground storage tanks, excavation and bioremediation of petroleum hydrocarbon contaminated soil; and performance of a Preliminary Endangerment Assessment (PEA). Dr. Callender coordinated the activities of several contractors, including demolition and remediation contractors, interacted with regulatory agencies and obtained closure status for the facility. Property has been redeveloped and is now used for commercial activities.

- Regulatory Compliance audit for manufacturing facility producing molded products. Evaluated compliance with RCRA, Cal OSHA and Hazardous Waste Management Regulations.

- Directed Phase I \Phase II site assessments of properties prior to acquisition of these properties for construction of the Domenigoni Valley Reservoir in Southern California. The client was the Metropolitan Water District of Southern California

- Project Manager for project investigating a state Superfund site. Project scope included development and implementation of a Remedial Investigation/Feasibility Study (RI/FS) and preparation of a Remedial Action Plan (RAP). Site was impacted by metals, primarily lead and hydrocarbons.

- Project Manager for several Phase II environmental site assessments to evaluate the presence and extent of contamination, and implementation of remediation programs. Projects include landfill investigations as well as assessments of industrial sites contaminated with halogenated solvents, petroleum hydrocarbons, and metals.

- Project Manager for Phase I environmental site assessments (ESAs) projects ranging in size from one site to as many as 150 sites. These ESAs have been conducted for real estate development companies, law firms, financial institutions and municipalities.

- Development and implementation of soil gas monitoring as an investigative tool at sites contaminated by volatile organic compounds, including landfill sites.

- Quality Assurance Officer for a U.S. EPA Superfund site investigation. Duties included preparation of the Quality Assurance Project Plan.

- Project Manager for a study evaluating U.S. EPA protocols for vadose zone monitoring at hazardous waste treatment facilities.

- Project Coordinator for a study evaluating the long-term environmental impacts of land treatment of oily residues from petroleum refineries.

Dr. Callender has worked on projects evaluating chemical and biological water quality in lakes and reservoirs. His experience in this area includes evaluating the quality of seepage water from reservoirs. He also worked on a project to optimize land treatment (Bioremediation) of oily residues.

As a private consultant to engineering firms, Dr. Callender has provided technical recommendations on monitoring of hazardous waste land treatment sites and monitoring and treatment of industrial wastes, particularly those generated by the food industry. He served as a lecturer in chemistry for several years at the College of Arts, Science and Technology in Jamaica.

Dr. Callender has provided expert witness testimony in cases involving the investigation and remediation of contaminated sites. He has also presented training seminars to the legal and banking professions on aspects of the waste management practice.

Publications / Lectures

Dr. Callender is the author or co-author of several technical publications. A list of publications is available on request.

Over the past 15 years, Dr. Callender has been a lecturer for the Environmental Programs at the University of California, Irvine Extension Program; the University of California, Riverside Extension Program; and the California State University, Long Beach Civil Engineering Department.

Barry Molnaa

Principal Environmental Scientist
Remediation Business Practice Manager

Education

M.P.M., Project Management, Keller Graduate School of Management, CA 1999

B.A. Biology, California State University, Fullerton, 1982

Mr. Molnaa is a senior environmental scientist with over 20 years experience. He has been instrumental in identifying and applying cost-effective remediation technologies on environmental projects throughout the Western United States and is a nationally recognized expert in aboveground and in-situ remediation technologies. He has been instrumental in the development of several innovative technologies for the treatment of inorganic compounds such as perchlorate and nitrate. He has worked closely with federal agencies such as EPA, state agencies such as California Department of Health Services (DHS), Department of Toxic Substances Control (DTSC), Regional Water Quality Control Board (RWQCB), and local agencies such as South Coast Air Quality Management District (SCAQMD). Mr. Molnaa has successfully negotiated closure of sites regulated by the DTSC, the RWQCB and local agencies such as County and City Fire Departments. He has authored numerous planning documents that have obtained regulatory approval under RCRA, CERCLA, and various local regulatory guidance.

Mr. Molnaa serves as an instructor for both Environmental Engineering and Project Management through UCLA Extension. He has taught courses in Remediation Methods and Technologies, Environmental Aspects of Soils Engineering and Geology, and Groundwater Monitoring, Protection and Clean up. Mr. Molnaa also developed the Sequential Certificate Program in Project Management currently offered by UCLA Extension.

Technology Development, Aquifer Restoration Project

Provided technical management for development of ion exchange technologies to remove perchlorate from drinking water. The site is currently being regulated by the RWQCB through several Clean up & Abatement Orders. The project included an evaluation of existing technologies, conducting field-scale pilot testing; developing an economic model, and preparing conceptual designs. Several innovative treatment methods were evaluated during the course of the project. In addition to developing the technology, it was necessary to understand the permitting and licensing requirements for each technology as it was being developed. The successful implementation of the project has led to the selection of a cost-effective treatment method for removing perchlorate from drinking water.

CERCLA Feasibility Study

Served as technical lead for the preparation of a Feasibility Study for treatment of soil and groundwater at a Superfund site in southern California. Soil and groundwater at the site contained elevated levels of DDT and the by-products of DDT production. The site is bordered by residential neighborhoods and light industry and receives a high level of regulatory and public scrutiny. The FS evaluated conventional and emerging technologies for treating DDT and chlorobenzene. Ultimately, the FS recommended construction of an earthen cap, installation of a soil vapor extraction system and hydraulic containment at the remedy. Corrective measures will be implemented following completion of interim measures addressing off-site issues. EPA Region IX has requested that contaminated soil from the adjacent properties be transported to the site and addressed as part of the complete remedy. The FS corrective measures were selected to address this request.

CERCLA Feasibility Study

Served as Technical lead for preparation of a Feasibility Study to address soil contaminated with PCBs and lead at a Superfund site in southern California. The site is an active light-industrial complex that had previously been used as a transformer storage facility. Past practices had contaminated soil at the site with high levels of PCBs and lead. The site was surrounded by residential neighborhoods and there was significant public pressure to implement a remedy that was protective of the public. The FS reviewed corrective measures in accordance with the NCP guidelines. Residents near the site were concerned that any remedy would disperse the PCBs and lead throughout the neighborhood. To address these concerns, the FS recommended construction of a cap to prevent further dust from leaving the site. The FS was approved and the remedy was successfully implemented without significantly impacting the on-site businesses or the neighboring residents.

Regulatory Interface and Compliance

Conducted regulatory interface activities for a Superfund project that includes treatment of groundwater for the removal of chlorinated hydrocarbons. The 9,000 gpm system delivers the treated water to a municipality for use as drinking water. Regulatory interface activities have included negotiating DHS permit conditions for the treatment plant, developing compliance plans for various inorganic (chrome) and organic (TCP) constituents not regulated under the Consent Decree, and meeting with EPA to discuss progress with the remediation. These efforts have successfully addressed issues regarding new constituents (specifically chrome and TCP) that were detected in groundwater. The plans developed to address these issues were approved by DHS and EPA with minimal comment. Successful implementation of the plans has allowed the system to operate without interruption.

On-call Environmental Services

Managed the on-call environmental services contract for the Port of Los Angeles (POLA). The scope of services contracted under this agreement include: preliminary site assessments (Phase I), remedial investigations/site characterizations (Phase II), remedial feasibility studies and action plans, site closure plans and reports, environmental compliance audits, regulatory agency coordination, third party review of environmental documents, oversight management of remediation work and data generation and transfer. This contract was awarded in 1999 and, to-date, thirteen projects have been successfully completed. The projects have included Phase I and Phase II assessments, environmental compliance audits, preparation of remediation plans, and oversight of remediation activities. This project has exceeded the MBE/WBE requirements of POLA.

Remediation and Redevelopment

Managed the installation of an in situ soil vapor extraction system in conjunction with property redevelopment. The site was a former oilfield that had been contaminated by a pipeline release of refined gasoline. The site was sold and retail buildings were scheduled for construction. The installation of the remediation system was coordinated with construction of retail buildings to facilitate occupancy of the stores. The remediation system is currently operating without impacting the retail outlets. The project required the development of an integrated team consisting of the former land owner, current land owner, developer, and City officials. The remediation effort is regulated by the City fire department and construction activities were regulated by the City building and safety department. Considerable negotiation between these two departments was required to facilitate co-construction of the remediation system and retail stores.

Closure SVE System

Successfully negotiated closure of a soil vapor extraction system with DTSC. The system had been operated by another consultant for a period of two years prior to taking over management of the project. Within 9 months, closure of the soil vapor extraction system had been granted by DTSC. The initial contamination had been discovered during the course of conducting a RCRA facility investigation. Two abandoned dry wells were removed and subsequent investigation found elevated levels of chlorinated hydrocarbons in soil and groundwater. The closure negotiation included conducting subsurface modeling of residual chlorinated hydrocarbons to determine if exposure pathways posed significant risks to human and environmental receptors. It was demonstrated that any residual concentrations would not migrate to indoor workspaces or impact groundwater. Through extended negotiations with the DTSC and discussions with their toxicologists, the modeling was validated and closure granted. The negotiations were complicated by the fact that both DTSC and RWQCB have oversight responsibilities. In an earlier agreement, DTSC granted oversight of the groundwater to RWQCB. Since the soil and groundwater remediation efforts are linked by the fact that residual soil contamination can impact groundwater, both agencies had to agree to the closure criteria. Efforts are now focusing on groundwater at the site. A Remedial Alternatives Evaluation was conducted to determine the best approach to treat the plume, which extends more that 8,000 feet downgradient from the site.

Technology Selection and Site Redevelopment, Former Refinery and Oil Production Facility

Participated in remedy selection and management of redevelopment project for former refinery and oil production site. Project involves treating petroleum-based hydrocarbons and sulfur-bearing compounds, such as mercaptans, thiophenes, and sulfides, to levels acceptable for redeveloping the land for residential use. The target constituents impacted a 9-acre area and extended to groundwater at a depth of 75 feet below ground surface. The system consists of approximately 375 vapor extraction wells connected to six different vapor treatment systems.

Technology Selection and Remediation, Chemical Distribution Center

Participated in remedy selection and management of vapor extraction system for treatment of chlorinated organic compounds for a site with 46 underground and 71 aboveground storage tanks. Releases from the tanks have impacted soil and groundwater over a 10-acre area.

Technology Selection and Remediation, Publication Distribution Center

Participated in remedy selection and management of dual-phase, high-vacuum extraction system at a publication distribution center. The hydrocarbon plume extends off-site, approximately 1,250 feet under adjacent property and busy city streets. The remediation system is designed to control off-site migration and remove source material. The system uses innovative vacuum mechanisms to generate very high (>25" Hg) vacuums to remove volatile hydrocarbons from fine-grained soils.

Remediation System Design and Construction Management

Designed and managed the construction of an innovative fixed-film bioreactor for treating groundwater containing high concentrations of gasoline and BTEX. This system is capable of meeting more stringent NPDES requirements.

Remediation System Design and Construction Management

Designed and managed construction of a permanent, aboveground bioremediation facility for heavy petroleum-contaminated soil at a Los Angeles refinery. The RWQCB Waste Discharge Permit for the facility was obtained in 2 months with no amendments required. Through innovative system management and utilization of refinery facility capital and human resources, treatment costs were lowered from $70 per ton to approximately $20 per ton. Overall cost reduction resulted in savings of approximately $3 million for the customer.

Microbial Inoculum Development

Developed microbial inoculums for enhancing wastewater treatment and degrading troublesome organic compounds. Microbial consortia will increase biological oxygen demand (BOD) removal, enhance anaerobic digester performance, treat high carbohydrate wastes, degrade petroleum hydrocarbons, and denitrify treated effluent from an oil refinery wastewater treatment system.

Regional Biotreatment Center Design, Nevada

Provided technical support and design for a regional biotreatment center for petroleum-contaminated soil, classified as nonhazardous. Once treated, the soil was used as fill material at the local landfill. The biotreatment facility consisted of four 1,000-cubic-yard treatment cells, constructed with berms and two monitoring wells at each end. Final construction of the cells was completed in August 1989; operation began the following month.

Regulatory Liaison, Midwest

Served as regulatory liaison for introduction of bioremediation into the Midwest. Responsible for conducting seminars on biological treatment alternatives for various federal, state, and local regulatory agencies in Kansas, Missouri, Oklahoma, and Texas.

Publications and Presentations

"Bioremediation: A Powerful and Resilient Companion Technology," Pollution Engineering, October 1999.

"Evaluation of Fixed-Film and Activated Sludge Bioreactors: A Comparative Study," presented at the In Situ and On-Site Bioreclamation Symposium, San Diego, California, April 1995.

"A Model to Calculate Optimum Particle Size for Above Ground Bioremediation Soil Treatment Cells," presented at the In Situ and On-Site Bioreclamation Symposium, San Diego, California, April 1995.

"The Use of Sparge Curtains for Contaminant Plume Control," presented at the HAZMAT WEST 94, Long Beach, California, November 1994.

"Bioremediation of Petroleum Contaminated Soils Using Indigenous Bacteria," presented at the Ventura Economic Development Association, Ventura, California, February 1992.

"Bioremediation Design Strategies," presented at the East Coast Conference on Hydrocarbon Contaminated Soils and Groundwater, Amherst, Massachusetts, September 1991.

"On-Site Remediation of Organically Impacted Soils on Oilfield Properties," presented at the Second Annual West Coast Conference on Hydrocarbon Contaminated Soils and Groundwater, Newport Beach, California, March 1991.

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Appendix D

Response to EPA Comments

ARCADIS

Subject: Response to EPA Comments dated October 19, 2004

Reference: Omega Small Volume Group Draft Remedial Investigation Work Plan, Omega Chemical Operable Unit 2, Whittier, Ca, Dated September 14, 2004

Dear Mr. Lichens:

The following summarizes our responses to comments forwarded in the subject transmittal from your office regarding the referenced document. The Remedial Investigation Work Plan for the Omega Chemical Operable Unit 2, Whittier, California (RIWP), has been amended to reflect these comments as noted below.

EPA Comment No. 1
The text should cite the Field Sampling Plan (FSP) prepared by CH2M Hill (2004) for EPA as the source of much of the text of the subject document, starting in Section 1.

Response to EPA Comment No. 1
The text has been modified to cite the FSP prepared by CH2M Hill as the source of much of the text of the RIWP.

EPA Comment No. 2
Page 1, second paragraph: The Weston report was dated 2003, not 2002. There is a typographical error in the FSP from which this paragraph was taken. In the same paragraph, the fourth sentence should be revised to read "...*various industrial activities were sent to the Omega facility for processing to form commercial products*." rather than... "*were processed at Omega to form commercial products*." since it has not been confirmed that Omega actually processed these materials.

Response to EPA Comment No. 2
The text has been modified as requested.

EPA Comment No. 3
Page 2, section 2.2, second paragraph: The first sentence in this paragraph should be revised to read... "*various industrial activities were sent for processing...*" rather than... "*were processed*".

Response to EPA Comment No. 3
The text has been modified as requested.

EPA Comment No. 4
Page 7, section 2.5, last paragraph: The first sentence in this paragraph should be revised to read "*...with the PRPs who had agreed to perform the work...*" rather than "*...with the PRPs who had agreed to complete the work...*"

Response to EPA Comment No. 4
The text has been modified as requested

EPA Comment No. 5
Page 8, last paragraph of Section 3.1: The citation is incorrect; The text says: "*However, toluene and acetone concentrations of up to 900 ug/l and 6,300 ug/l, respectively, have been detected in samples collected from Well OW8 located down-gradient of the Omega site. These compounds appear to be from a different down gradient source (CDM 2003b).*" The cited document discusses aromatic compounds in Section 3.3.2 and summarizes the conclusions regarding contaminant transport in Section 4; it does not, however, infer a different source for toluene and acetone than the Omega Site. No such source has been identified and existing data do not support the conclusion that contamination found in groundwater samples from Well OW8 originated from a source other than the Omega Site.

Response to EPA Comment No. 5
The text has been modified as requested. It is understood that EPA does not believe a down gradient source has been identified, but it should be noted that the sentence quoted in EPA Comment No. 5 was taken directly from the referenced document.

EPA Comment No. 6
Page 9, second paragraph of Section 3.2: The following sentence from CH2M Hill's FSP (2004) was omitted: "*Because the majority of the monitoring points that have been used to define the VOC plumes are based on in situ groundwater samples from CPT soundings, which sample only a very small depth interval, it is possible that some of the lateral variation in concentrations is a result of the limitations of this sampling technique.*" This qualifying statement is relevant to the discussion of the Weston (2003) concentration contour maps and the continuity of the contaminant plumes. The goal of the current investigation is to address these data gaps.

Response to EPA Comment No. 6
The referenced paragraph has been included in the Final RIWP.

EPA Comment No. 7
Page 9, fourth paragraph of Section 3.2; This comment ties to the previous one. The sentence "*...however, the data may also be interpreted as one continuous plume similar to the Freon 113 plume...*" was excluded. The excluded statement offers an alternative interpretation of the Freon 11 distribution in groundwater than shown in the Weston (2003) map.

Response to EPA Comment No. 7
The referenced sentence has been included in the Final RIWP.

EPA Comment No. 8
Page 10, fifth paragraph of Section 3.2: The statement "*... however, the data generally does not establish this...*" was appended to the sentence. "*Locally, the contamination may be present in deeper, highly permeable units that serve as preferential groundwater flow pathways.*" The sentence: "*Again the existing data do not show this to be occurring...*" was added to the end of the paragraph after a statement regarding the potential contaminant migration into greater depths. Note that the data for the deeper aquifer zones are not available. It is the objective of this investigation to characterize the vertical extent of the contamination in OU-2, as well as the potential presence of preferential groundwater flow pathways. Note that the statements in the FSP (CH2M Hill, 2004) are conditional (e.g., *may*), not definitive.

Response to EPA Comment No. 8
The text in the RIWP will be amended as indicated.

EPA Comment No. 9
Page 10-11, second paragraph of Section 3.3: The text presents a value of advective velocity (the term "groundwater flow rate" is used in the text) calculated from estimated aquifer parameters. The hydraulic conductivity values reported for the Omega Site (CDM, 2003) and the WDI Site (CDM, 1999) are representative of a small volume of the shallow aquifer at each location. The value for the Omega Site was estimated from a slug test conducted on a well installed in a fine-grained unit. A coarser, sandy unit is present about 300 feet down gradient of the tested well; the sand is expected to have a significantly higher hydraulic conductivity. The flattening of the water table contours downgradient of Omega also indicates more permeable shallow aquifer material is present in this area compared to the soils beneath the Omega Site. Coarse-grained units are present within the known extent of the contaminated shallow aquifer. It is therefore expected that the average hydraulic conductivity of the shallow aquifer across the plume will be higher than the conductivity of the fine-grained units present at the Omega and WDI sites. Consequently, the advective velocity is also expected to be higher. The planned aquifer testing program will further address these issues.

The apparent plume migrating rate estimated by CH2M Hill (2004) and average advective velocity will eventually be compared and differences reconciled, through additional records search and numerical modeling suing all available data.

Response to EPA Comment No. 9.
It is agreed that additional investigation and data review is necessary to more accurately determine the advective velocity.

EPA Comment No. 10
Page 11, section 3.7: The second sentence should be revised to read *"IOU-2, also known as the Phase 1a Area, includes..."*

Response to EPA Comment No. 10
The revision has been made in the Final RIWP.

EPA Comment No. 11
Page 12, Section 4.2: Revise the sentence: *"The approach to the work plan has been directed by the U.S. EPA in their UAO, and by CH2M Hill in their SAP of July, 2004."* To read: *"The approach to the work plan has been directed by the U.S. EPA in their UAO and SAP of July 2004."*

Response to EPA Comment No. 11
The sentence has been changed.

EPA Comment No. 12
Page 13, last paragraph: The use of sonic drilling is not recommended for monitoring and extraction well installation. Sonic drilling results in the compaction of aquifer material that impacts aquifer testing. Similarly, mud drilling should be considered only if mud-free drilling methods are determined to be impractical.

Response to EPA Comment No. 12
Per discussions between EPA representatives and OSVOG representatives on October 26, 2004, the use of sonic drilling with a specialized bit that will help minimize compaction of the aquifer materials followed by proper well development may be employed as a method of well drilling. The Sampling and Analysis Plan will detail the type of drilling to be implemented at various locations.

EPA Comment No. 13
Page 14, statement following bullets: The use of temporary well points to evaluate groundwater quality prior to monitoring well installation should be discussed further with EPA as soon as possible, and certainly before such an approach is included in the Field Sampling Plan. During an August 19, 2004 meeting, EPA encouraged OSVOG to provide any suggestions regarding alternative field procedures as soon as possible. However, with the exception of the statement in the work plan regarding temporary well points, no such suggestions were ever received.

Response to EPA Comment No. 13
Per discussions between EPA representatives and OSVOG representatives on October 26, 2004, the use of Cone Penetrometer Testing (CPT) equipment may be utilized to help identify the lithology and water quality at the predetermined well locations along the leading edges of the plume. This work will be performed to aid in locating suitable locations for permanent wells prior to installation of the permanent wells.

EPA Comment No. 14
Please note that the Project Schedule in Appendix B does not relieve OSVOG of any deadlines specified in UAO-9-2004-004.

Response to EPA Comment No. 14
It is understood that the deadlines specified in UAO-9-2004-004 shall be met. Amended project schedules will be provided to EPA as necessary during project execution. It should be noted that the EPA review times included in the current schedule are estimates only.